GENERAL ZOOLOGY

or

SYSTEMATIC NATURAL HISTORY

by

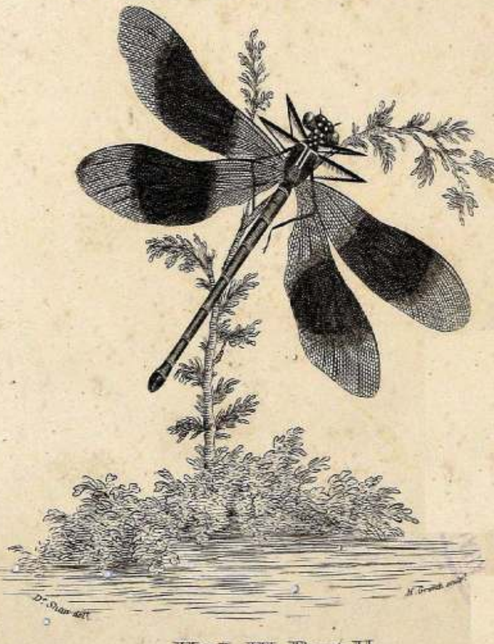
GEORGE SHAW, M.D. F.R.S &c.

WITH PLATES

from the first Authorities, and most select specimens

Engraved by

Mr HEATH & Mrs GRIFFITH.



VOL. VI. Part II.

INSECTA.

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The Vignette represents the *Libellula Virgo* of Linnæus, or Golden-Green Dragon-Fly. It varies occasionally in colour, but is generally seen with the wings marked in the middle by a very large, oval, black or violet-blue patch, and is one of the most common of the British Libellulæ.

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INSECTS.

ORDER

NEUROPTERA.

LIBELLULA. DRAGON-FLY.

Generic Character.

Os maxillosum, maxillis pluribus.	*Mouth* furnished with several jaws.
Antennæ brevissimæ.	*Antennæ* very short.
Alæ exstensæ.	*Wings* four, extended.
Cauda maris hamoso-forcipata.	*Tail* (in the male) hook-forcipated.

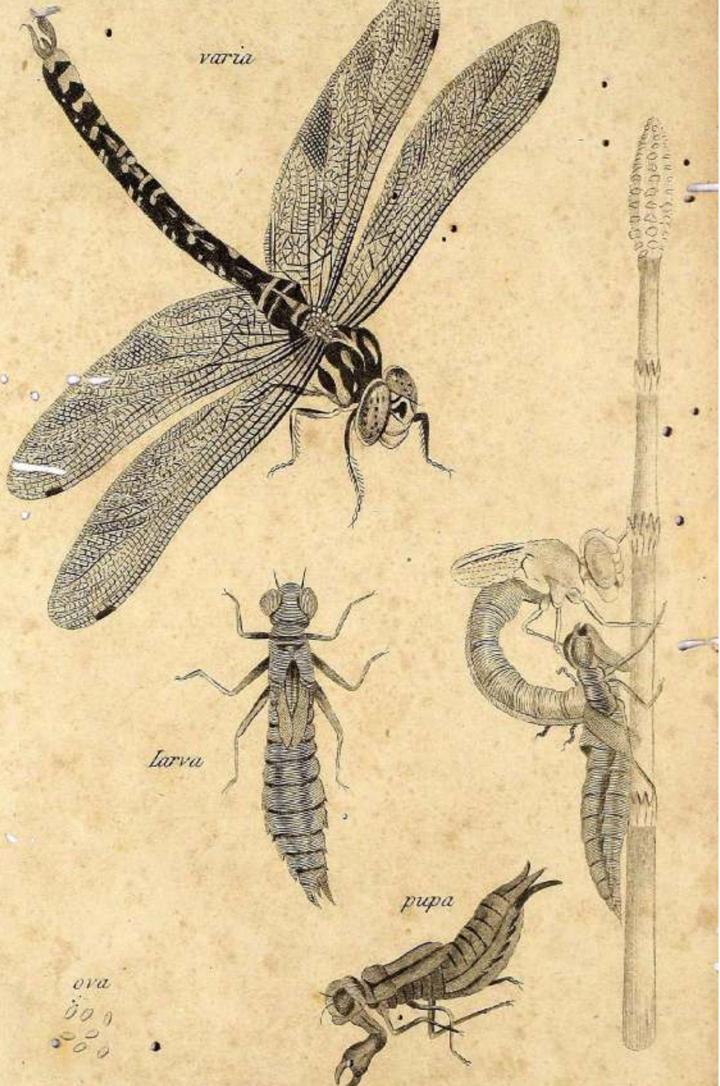
IN this genus the mouth is furnished with several lateral mandibles, denticulated at the tip: the antennæ are very short, being merely a pair of small hairs: the wings large and spreading, and the body lengthened.

The Libellulæ or Dragon-Flies, sometimes called by the very improper title of Horse-Stingers, exhibit an instance scarcely less striking than the

Butterfly of that strange dissimilitude in point of form under which one and the same animal is destined to appear in the different periods of its existence. Perhaps few persons not particularly conversant in the history of insects would imagine that these highly brilliant and lively animals, which may be seen flying with such strength and rapidity round the meadows, and pursuing the smaller insects with the velocity of a hawk, had once been inhabitants of the water, and that they had resided for a very long space of time in that element before they assumed their flying form. Of the Libellulæ there are many different species, both native and exotic. The most remarkable of the English species is the *Libellula varia* *, or great variegated Libellula. This insect makes its appearance principally towards the decline of summer, and is an animal of singular beauty: its general length is about three inches from head to tail, and the wings, when expanded, measure near four inches from tip to tip: the head is very large, and affixed to the thorax by an extremely slender neck: the eyes occupy by far the greatest part of the head, and are of a pearly blue-grey cast, with a varying lustre: the front is greenish yellow; the thorax of the same colour, but marked by longitudinal black streaks: the body, which is

* It is here called by a new title, the more securely to distinguish it from the L. grandis of Linnæus, with which it is generally confounded; partly from the misapplication of Synonyms by Linnæus himself.

LIBELLULA.



M. Griffith sculp.

1803, Oct.r 1 London Published by G. Kearsley, Fleet Street.

very long, slender, and subcylindrical, is black, with rich variegations of bright blue, and deep grass-green: the wings are perfectly transparent, strengthened by very numerous black reticular fibres, and exhibit a strongly iridescent appearance, according to the various inflexions of light: each is marked near the tip by a small oblong-square black spot on the outer edge: the legs are black, and the tail is terminated by a pair of black forcipated processes, with an intermediate shorter one of similar colour. Sometimes this insect varies; the spots or marks on the abdomen and thorax being red or red-brown instead of green. In its motions it is extremely rapid, flying about in pursuit of its prey during the middle of the day, and is at this time taken with extreme difficulty, darting off, on the slightest alarm from the spot on which it had settled, and in the space of a second or two flying to a vast distance. During the early morning hours, and those of evening, it is easily taken: at such times it is observed to sit with its wings expanded, but in a perfectly inert state, and will suffer itself to be readily seized by one of its wings, without attempting to stir from its place.

The female Libellula deposits or drops her eggs into the water, which sinking to the bottom, are hatched, after a certain period, into hexapode flattish larvæ or caterpillars, of a very singular and disagreeable aspect: they cast their skins several times before they arrive at their full size, and are of a dusky-brown colour: the rudiments of the future

wings appear on the back of such as are advanced to what may be called the pupa or chrysalis state, in the form of a pair of oblong scales or processes, and the head is armed with a most singular organ for seizing its prey; viz. a kind of proboscis, of a flattened form, and furnished with a joint in the middle, the end being much dilated, and armed with a pair of strong hooks or prongs. This proboscis, when the animal is at rest, is folded or turned up, in such a manner as to lap over the face like a mask; but when the creature sees any insect which it means to attack, it springs suddenly forwards, and by stretching forth the jointed proboscis, readily obtains its prey. These larvæ are excessively voracious, and like those of the Dytisci, commit great havoc among the smaller water insects in general. Linnæus calls them "*Crocodili crudeles insectorum aquatilium.*" They continue in this their larva and pupa state for two years, when, having attained their full size, they prepare for their ultimate change; and creeping up the stem of some water-plant, and grasping it with their feet, they make an effort, by which the skin of the back and head is forced open, and the inclosed Libellula gradually emerges; it first puts forth its head and wings, and afterwards draws out the body, in the manner represented on the annexed plate. The wings, at this early period of exclusion, like those of butterflies, are very short, tender, and contracted, all the ramifications or fibres having been compressed within the small compass of the oblong scales on the back of the

larva, or rather pupa; but in the space of about half an hour they are fully expanded, and have acquired the solidity and strength necessary for flight. This curious process of the evolution or birth of the Libellula generally takes place in the morning, and during a clear sunshine. The remaining part of the animal's life is but short in comparison with that which it passed in its aquatic state; the frosts of the close of autumn destroying the whole race. They are also the prey of several sorts of birds. It is impossible not to be struck with admiration on contemplating the changes of the Libellula, which, while an inhabitant of the water, would perish by any long exposure to the air, while the complete animal, once escaped from the pupa, would as effectually be destroyed by submersion under the water, of which not an hour before, it was the legitimate or natural inhabitant.

The *Libellula depressa* is a smaller or shorter species than the preceding, though with a considerably broader body in proportion. The male is of a bright sky-blue, with the sides of the body yellow; the female of a fine brown or bay, with yellow sides also: the wings in both sexes are transparent, except at the shoulders, where they are each marked by a broad bed or patch of brown with a stripe of yellow: the tips of each wing have also a small oblong-square black spot on the outer margin. The larva of this species is of a shorter form than that of the preceding, and is of a greenish brown colour.

The *Libellula Virgo* is one of the most elegant of the European insects: it is much smaller than the Libellula varia, and is distinguished by its very slender, long, cylindric body, which, as well as the head and thorax, is usually either of a bright but deep golden-green, or else of a deep gilded-blue: the wings are transparent at the base and tips, but are each marked in the middle by a very large oval patch or bed of deep blackish or violet blue, accompanied with iridescent hues according to the direction of the light: sometimes the wings are entirely violet-black, without the least appearance of transparency either at the base or tips; and sometimes they are altogether transparent, without any appearance of the violet-black patch which distinguishes the majority of specimens; and lastly the insect sometimes appears with transparent wings, but shaded with a strong cast of gilded greenish brown, each being marked by a small white speck at the exterior edge, near the tip. All these varieties may often be observed in the same field, or flying within a small distance of each other on the borders of their natal stream. The larva of this species is of a very slender form, and has the tail terminated by three large oblong-oval leaf-shaped appendages. Like those of the two preceding species, it is very common in stagnant waters and in rivulets.

A much smaller species than the preceding, and equally common, is the *Libellula Puella* of Linnæus. This varies much in colour, but is gene-

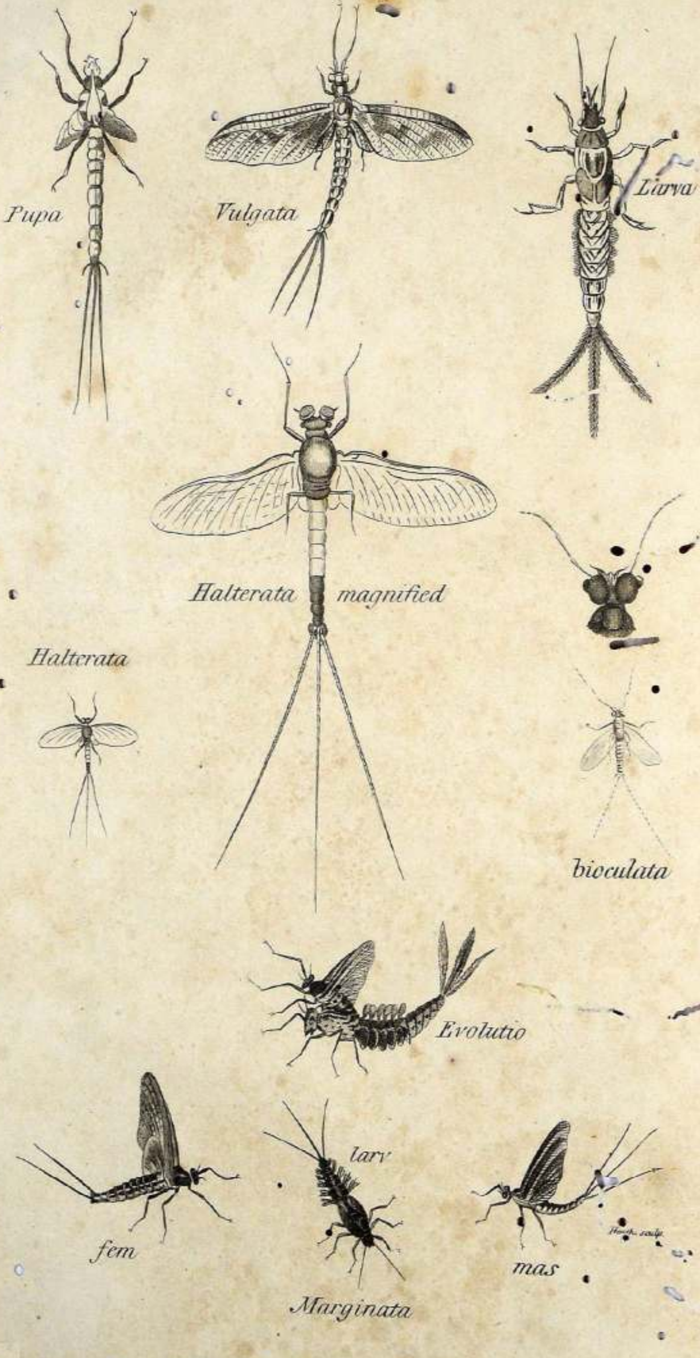
rally of a bright and beautiful sky-blue, variegated with black bars on the joints, and with the thorax marked by black longitudinal stripes: the wings are transparent, and each marked near the tip with a small oblong-square black marginal spot: the head in this species, as well as in the L: Virgo, is broader and narrower in proportion than that of the L: varia, and the eyes are round, protuberant, and placed on each side at a distance from each other, instead of coalescing at the upper part as in the L: varia: this species often varies; being red or brown instead of blue. Its larva resembles that of the L: Virgo in shape, but is proportionally smaller, and, like that, is also furnished with three large, lengthened-oval, leaf-shaped appendages.

The exotic Libellulæ are very numerous: among the most remarkable may be numbered the *L: Lucretia*, figured in the elegant entomological work of Mr. Drury. It is a native of the Cape of Good Hope, and is distinguished by the excessive length of its slender body, which measures not less than five inches and a half in length, though scarcely exceeding the tenth of an inch in diameter: the wings are transparent, of a slender or narrow shape, as in the L: Puella, to which this species is allied in form, and measures five inches and a half in extent from tip to tip: the colour of the head and thorax is brown, with a yellowish stripe on each side, and the body is of a deep mazarine blue.

I should not dismiss the genus Libellula with-

out observing that in some species, and particularly in the L: varia, grandis, &c. the wonderful structure of the cornea or external coat of the eye, which prevails in by far the major part of the insect tribe, is exhibited with peculiar distinctness. Even a common magnifier, of about an inch focus, demonstrates that the cornea is marked by a prodigious number of minute decussating lines, giving a kind of chagrin or granular appearance to the whole convexity: but when microscopically examined, it exhibits a continued surface of convex hexagons, and if cut from the head, and cleared from its internal pigment, it appears perfectly transparent, and seems to consist of an infinity of hexagonal lenses of equal convexity on both surfaces. This is a subject on which much might be said; but the compass of the present publication forbids too circumstantial a description of minute and disputable particulars. It may be sufficient to observe that on each eye of this animal, according to computation of Leewenhoek, there are about twelve thousand five hundred and forty-four of these lenses.

EPHEMERA


Pupa
Vulgata
Larva
Halterata magnified
Halterata
bioculata
Evolutio
larv
fem
mas
Marginata

EPHEMERA. EPHEMERA.

Generic Character.

Os edentulum, absque palpis.	*Mouth* without teeth or feelers.
Stemmata duo, maxima, supra oculos.	*Stemmata* two, very large, above the eyes.
Alæ quatuor, erectæ; posticis minoribus.	*Wings* upright; the lower pair smaller.
Cauda setosa.	*Tail* bristled.

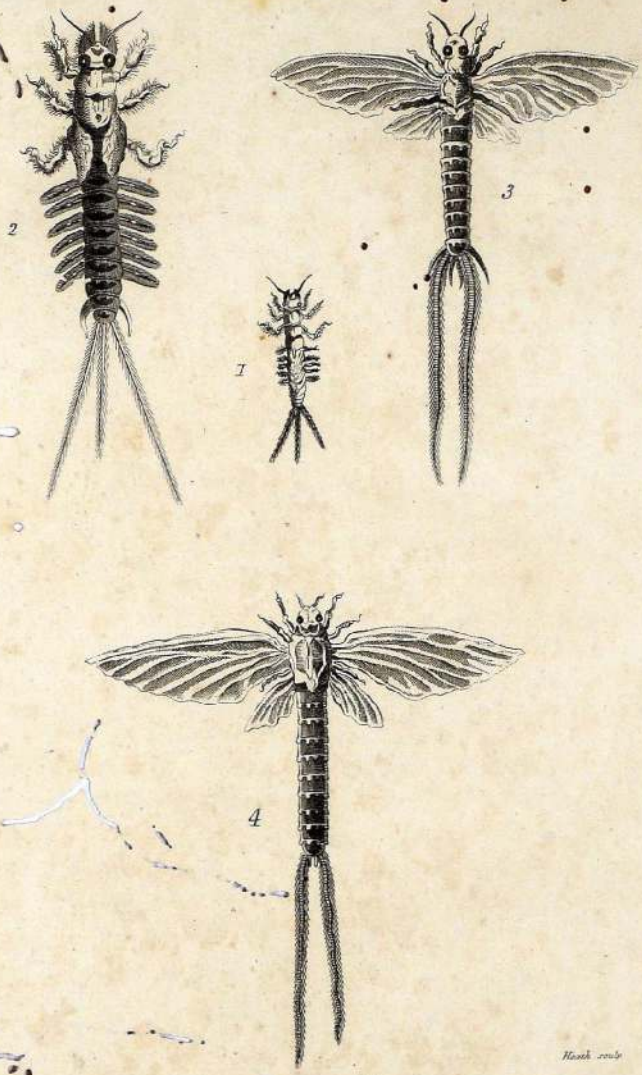
THIS genus, like that of Libellula, exhibits a wonderful difference between the same animal in its larva state and that of its ultimate or perfect state; the larva being altogether aquatic, the complete insect aërial. It also affords an example of what may be termed a flying pupa; since, in some species at least, the insect is no sooner evolved from the larva than it flutters to the nearest convenient spot, and again shifts its pellicle*, the wings themselves having cast their exterior membrane. The Ephemeræ are extremely short-lived insects. The most familiar species is the *Ephemera vulgata* or common May-Fly, so plentiful in the early part of summer about the brinks

* This operation is so quick that it may be rather called springing from the chrysalis than gradually emerging.

of rivulets and stagnant waters. It is of a greenish brown colour, with transparent wings, elegantly mottled with brown, and is furnished at the extremity of the body with three very long black bristles. It flutters during the evening about the surface of the water, but during the day is generally seen in a quiescent posture, with the wings closed, and applied to each other in an upright position. The larva is of a lengthened shape, about an inch in length, furnished along each side of the body with several finny plumes, and at the tail with three long, feathered processes: it has also a pair of moderately long antennæ, though those of the complete insect are extremely short. When arrived at its full size, as above-described, it exhibits the rudiments of wings on the back, in the form of a pair of oblong sheaths or scales: its colour is a pale yellowish or whitish brown. It is supposed to continue two years in this state of Larva before it changes into the complete insect. This change takes place in the evening, when the larva rises to the surface of the water, and soon divesting itself of its skin, flies to some neighbouring object, and after having remained some time longer, again casts its pellicle, and appears in its ultimate or perfect form, in which, as well as in its larva state, it is a favourite food of several kinds of fishes, and particularly of the Trout. In some seasons it is extremely plentiful, the air in the immediate neighbourhood of its natal waters being frequently blackened by its numbers during the evening hours. We are assured by Scopoli, that such

EPHEMERA.

Swammerdamiana



Heath sculp

1 larva in the first year's growth
2 larva full grown
3 male Ephemera
4 female Ephemera

1805 Oct.r 1.st London Published by G. Kearsley Fleet Street

swarms are produced every season in the neighbourhood of some particular spots in the Dutchy of Carniola, that the countrymen think they obtain but a small portion, unless every farmer can carry off about twenty cart-loads of them into his fields, for the purpose of a manure*.

But, of all the European Ephemeræ, that which has been most celebrated, and of which almost every reader must recollect the general and superficial account so often detailed in works of Natural History, is the species described by Swammerdam †. It is of a white colour, with the anterior rib of the upper wings black or deep-brown, and the tail is furnished with two long bristles. This insect, which is common in many parts of Europe, is commemorated as a most remarkable instance of the brevity of animal life; since after its change into the perfect animal it survives but a very few hours, perishing in the course of the same evening that gave it birth. It is to be recollected however that its larva lives in its aquatic state two, and even sometimes nearly three years; and is in this state so tenacious of life that Swammerdam assures us that one which he pierced with a pin to a board, in order to preserve it, lived all

* It is necessary to give the words of the author himself. What particular kind of vehicles he intended by the word *currus* I know not. "Junio mense tanta copia circa *Laz* Carniolæ conspicua, ut rustici exiguam messem se collegisse putent, nisi singuli ultra 20 currus ea onustos in agrum exoneraverint, cujus stercorationi optime inservit."

† *Ephemera horaria??* Lin.

the next day notwithstanding. According to the figure given by Swammerdam it is extremely allied to the larva of the Ephemera vulgata, residing chiefly in tubular cavities which it forms in the mud or clay of the waters it inhabits, occasionally coming out in quest of food. In this respect it agrees with the larvæ of several others of this genus, which have a similar habit of forming tubular hollows in the banks of their native waters. When arrived at full growth the larva or, more properly, pupa, rises, like that of the common Ephemera, to the surface of the water, generally between the hours of six and seven in the evening, and the skin of the back cracking, and springing off with an elastic motion, the Fly is almost instantaneously evolved, as in the common species; after which it flies to the nearest convenient spot, and again divesting itself of its pellicle, appears in its perfect or ultimate state. It now flies again to the water, and fluttering over its surface, as if sporting with its innumerable companions, enjoys all the pleasures of its short remainder of existence: the female breeds, deposits her eggs, and, like the male, perishes before or with the dawn of the approaching day.

This species, according to Swammerdam, is extremely frequent in the mouths or entrances of the Rhine, the Maes, the Wael, the Leck, and the Isel. It appears in the fly or perfect state about midsummer, and the season of its appearance lasts only three days, none being seen again till the following year.

According to Swammerdam's figure the size of the animal is at least equal to that of the Ephemera vulgata, from which it principally differs in being of a white colour, and in having but two caudal bristles, though in its larva state it was furnished with three.

Among the smaller Ephemeræ the species are by no means easily distinguishable, and a degree of confusion seems to prevail in their synonyms as given by Linnæus and others.

Among these smaller species the *Ephemera halterata* of Linnæus may be considered as one of the most elegant: it is of a white colour, with the lower part of the body black: the lower wings are so very small as rather to resemble a mere pair of small membranaceous processes than real wings. It is not uncommon during the summer months. The stemmata or false eyes are in this species remarkably conspicuous, and are of a flattened surface: the tail is terminated by three long bristles.

Ephemera diptera of Linnæus is a somewhat larger species than that just mentioned, and has, as the name imports, only two wings, no traces of lower wings being discoverable. The body is brownish, and the wings white, with a strong anterior rib or border of yellow-brown, varied by cinereous spots.

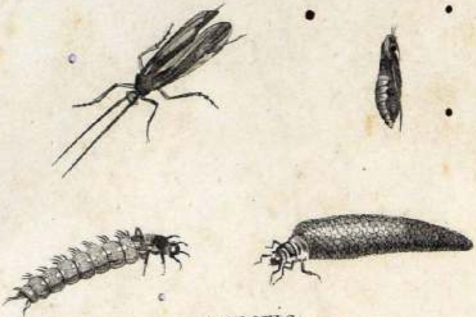
PHRYGANEA. PHRYGANEA.

Generic Character.

Os edentulum: Palpis quatuor.	*Mouth* without teeth; with four Feelers.
Stemmata tria.	*Stemmata* three.
Antennæ thorace longiores.	*Antennæ* longer than thorax.
Alæ incumbentes: inferioribus plicatis.	*Wings* incumbent; the lower pair pleated.

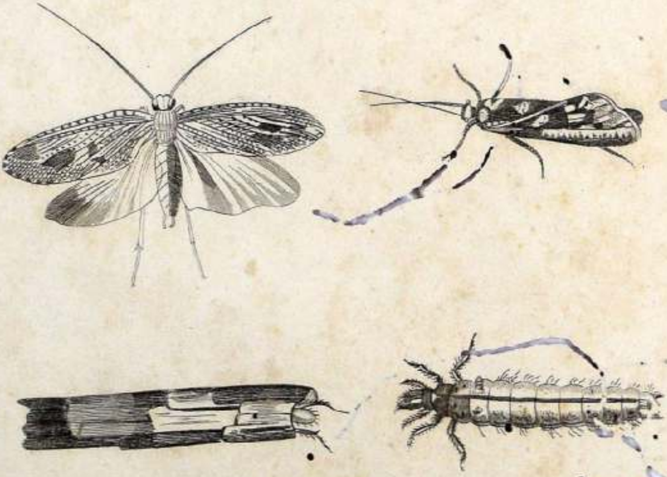
THE genus Phryganea consists of insects which in point of habit or general appearance bear a considerable resemblance to some of the Phalænæ, and particularly to those belonging to the division entitled Tineæ. They may however be readily distinguished from Moths by their palpi or feelers, as well as by the stemmata situated on the top of the head. The Phryganeæ proceed from aquatic larvæ of a lengthened shape, residing in tubular cases, which they form by agglutinating various fragments of vegetable substances, particles of gravel, &c. &c. These tubular cases are lined within by a tissue of silken fibres, and are open at each extremity. The included larvæ, when feeding, protrude the head and fore-parts of the

PHRYGANEA.



arenaria

rhombica



grandis

Heath sculp.

1808, Octr 1 London Published by G. Kearsley, Fleet Street.

body, creeping along the bottom of the waters they inhabit by means of six short and slender legs: on the upper part of the back, in most species, is situated an upright papilla or process, serving as a kind of prop or stay, preventing the case or tube from slipping too forwards during the time the animal is feeding.

Of the European Phryganeæ one of the largest is the *Phryganea grandis* of Linnæus, usually measuring somewhat more than an inch in length, and having very much the general aspect of a phalæna: the upper wings are grey, marked by various darker and lighter streaks and specks, and the under wings yellowish brown and semitransparent. The larva, which measures near an inch and three quarters in length, is of a flesh-coloured grey, with brown head, and legs, and inhabits a tube composed of pieces of bark, small fragments of grass-stalks, or other substances. Like other larvæ of this genus, it is known by the name of Cadew-Worm, and is frequently used by anglers as a bait. When arrived at full growth it fastens the case or tube by several silken filaments to the stem of some water plant or other convenient substance in such a manner as to project a little above the surface of the water, and casting its skin, changes to a chrysalis of a lengthened shape, and displaying the immature limbs of the future Phryganea, which in the space of about fourteen days emerges from its confinement.

Phryganea rhombica is a smaller species than

the former, and is of a yellowish brown colour, with two obliquely transverse rhomboid semi-transparent white spots on each upper wing; the lower wings being whitish with a tinge of yellow-brown towards the upper edge. The larva forms its case of small pieces of the slender stems of water grasses or other plants curiously disposed in an obliquely transverse direction. It is of a greenish brown colour, and like the former, is found in rivulets and stagnant waters. The Larvæ of the Phryganeæ in general feed not only on the smaller water insects but on the spawn of fishes, and even on the young fry itself.

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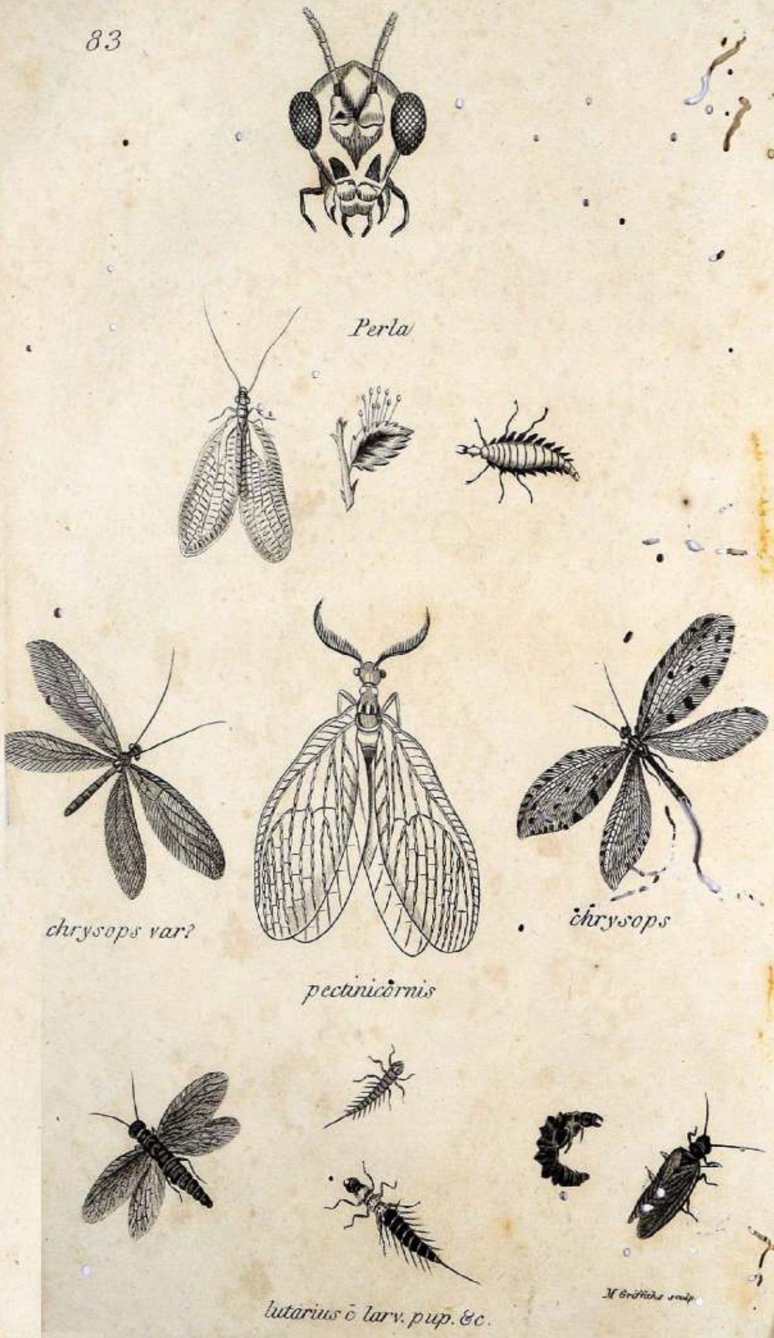


1805. Oct 1 London. Published by G. Kearsley. Fleet Street.

Generic Character.

Os dentibus duobus; Palpis quatuor.	*Mouth* with two teeth, and four Feelers.
Stemmata nulla.	*Stemmata* none.
Alæ deflexæ (nec plicatæ.)	*Wings* deflected, not pleated.
Antennæ thorace convexo longiores, setaceæ, porrectæ.	*Antennæ* longer than the convex thorax, setaceous, stretched forwards.

THE genus Hemerobius is distinguished by a peculiar delicacy of appearance. The most common species, the *Hemerobius Perla*, is an insect of extreme beauty. It is principally seen in the middle and towards the decline of summer, and is a slender-bodied fly of a grass-green colour, with bright gold-coloured eyes, and four large, transparent, oval wings finely reticulated with pale-green veins. The general length of the animal, from the head to the tips of the wings, is about three quarters of an inch. It is not uncommon in the neighbourhood of gardens, occasionally flying into houses. If pressed or bruised it diffuses an odour of the most disagreeable kind, and

which remains a considerable time on the fingers. The eggs laid by this insect are of a highly curious appearance, and at first view resemble rather some production of the vegetable than the animal kingdom, being each supported on a delicate stem of more than half an inch in length, which is attached to the surface of some leaf or twig. Groupes of these eggs are frequently observed on the lime-tree in particular, and have occasionally been mistaken by those who were ignorant of their real nature for some small species of parasite fungus. They have long ago been well figured in the works of Reaumur, &c. From these eggs are hatched small larvæ of an oblong-oval shape with a pointed extremity. They grow to the length of about three quarters of an inch, and are of a flattish or slightly convex surface, and a reddish colour: the abdominal divisions project in a serrated manner on each side the body, and the head is armed in front with a pair of short, curved, tubular forceps, by which the animal seizes and sucks the juices of its prey. These larvæ live almost entirely on Aphides, which they devour with great avidity: their growth is pretty quick, and in the space of about a fortnight they are ready to undergo their change into the chrysalis state. In order to this, the animal draws a fine silk from the extremity of its body, and in a short space envelops itself in a round ball, of the size of a small pea, affixed to a leaf or twig of the tree it frequents, and, divesting itself of its skin, com-

mences a chrysalis, which in the space of about twenty* days affords the complete insect. It is wonderful, as Reaumur very justly observes, that an insect with such an expanse of wing should be contained within the small compass of the silken ball of the chrysalis.

The Hemerobius Perla, like its larva, is of a predacious nature, living on the smaller kind of flying insects.

Hemerobius chrysops greatly resembles the preceding, but differs in having the body and thorax marked by black spots, and the wings by dusky reticular variegations.

* According to Albin the larva incloses itself in the ball in August, and the fly emerges in the following May. Reaumur observes that those which change to chrysalis early in summer emerge from it in about three weeks, while those which change in September continue in chrysalis till the following spring.

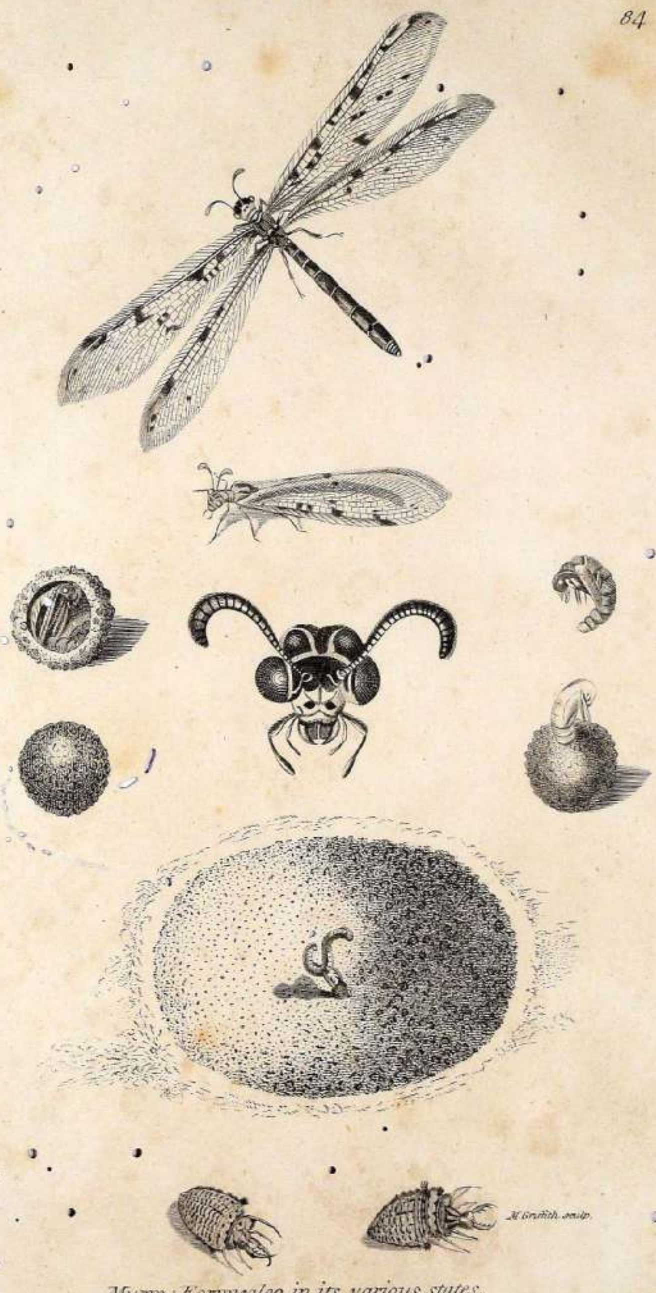
MYRMELEON. MYRMELEON.

Generic Character.

Os maxillosum, dentibus duobus. Palpi quatuor elongati.	*Mouth* furnished with jaws: teeth two: Feelers four, elongated.
Stemmata nulla.	*Stemmata* none.
Antennæ clavatæ, longitudine thoracis.	*Antennæ* clavated, of the length of thorax.
Alæ deflexæ.	*Wings* deflected.
Cauda maris forcipe a filamentis duobus rectiusculis.	*Tail* of the male furnished with a forceps consisting of two straitish filaments.

OF this genus the species whose history is best understood is the *Myrmeleon Formicaleo* of Linnæus, whose larva* has long been celebrated by naturalists for its wonderful ingenuity in preparing a kind of pitfal or deceptive cavity for the destruction of such insects as happen unwarily to enter it. The *Myrmeleon Formicaleo* in its complete or fly state bears no inconsiderable resemblance to a small Dragon-Fly, from which however it may readily be distinguished by its antennæ.

* Popularly known by the name of Lion-Pismire.



M. Griffith sculp.

Myrm: Formicaleo in its various states.

1803. Oct. 1 London. Published by G. Kearsley, Fleet Street.

It is of a predacious nature, flying chiefly by night, and pursuing the smaller insects in the manner of a Libellula. It deposits its eggs in dry sandy situations, and the young larvæ, when hatched, begin separately to exercise their talent of preparing, by turning themselves rapidly round, a very small conical cavity in the sand. Under the centre of the cavity the little animal conceals itself, suddenly rushing forth at intervals in order to seize any small insect which by approaching the edge of the cavity has been so unfortunate as to fall in, and after sucking out its juices through its tubular forceps, throws it by a sudden exertion to some distance from the cavity. As the creature increases in size it enlarges the cavity, which at length becomes about two inches or more in diameter. The larva when full-grown is more than half an inch long, and is of a flattened figure, broad towards the upper part, and gradually tapering to an obtuse point at the extremity. It is of a brown colour, and beset with numerous tufts of dusky hair, which are particularly conspicuous on each side the annuli of the abdomen: the legs are slender: the head and thorax rather small: the tubular jaws long, curved, serrated internally, and very sharp-pointed. The whole animal is of an unpleasing aspect, and on a cursory view bears a general resemblance to a flat-bodied spider. When magnified its appearance is highly uncouth.

The ingenious Reaumur and Roësel have given accurate descriptions of this larva and its extra-

ordinary history. It is one of those whose term of life, like that of the Libellulæ and Ephemeræ, is protracted to a very considerable space, since it survives the first winter in its larva state, taking no nourishment during that time, and in the spring resumes its usual manner of preying. In preparing its pit it begins by tracing an exterior circle of the intended diameter of the cavity, continuing its motion, in a spiral line, till it gets to the centre, thus marking several volutes in the sand, resembling the impression of a large helix or snail-shell; and after having sufficiently deepened the cavity by a repetition of this motion, it smooths the sides into a regular shape by throwing out the superfluous sand lying on the ridges: this it does by closing its forcipes in such a manner that together with the head, they form a convenient shovel, with which it throws the sand with so strong a motion out of the cavity, that the grains often fall to the distance of near a foot beyond the brink. The depth of the pit is generally equal to the diameter. When full-grown and ready to change into a chrysalis the animal envelops itself in a round ball of sand, agglutinated and connected by very fine silk, which it draws from a tubular process at the extremity of the body: with this silk it also lines the internal surface of the ball, which, if opened, appears coated by a fine pearl-coloured silken tissue. It continues in the state of chrysalis about four weeks, and then gives birth to the complete insect. The *Myr-*

M Griffith sculp.

grande.

1805. Oct.r 1 London; Published by G Kearsley, Flee[t] Street.

meleon Formicaleo is not found in England, but occurs in many parts of the Continent, as France, Spain, Germany, &c.

Some of the extra-European species of this genus are of very considerable size, and of a highly elegant appearance.

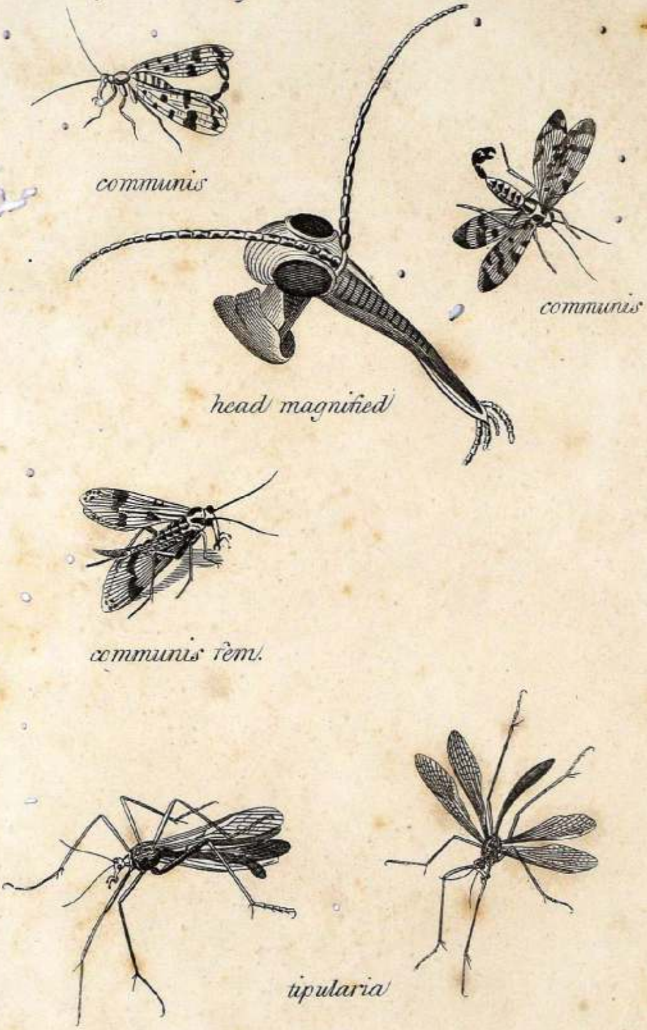
PANORPA. PANORPA.

Generic Character.

Rostrum corneum, cylindricum; palpis duobus.	*Snout* horny, cylindric, with two feelers.
Stemmata tria.	*Stemmata* three.
Antennæ thorace longiores.	*Antennæ* longer than thorax.
Cauda maris chelata.	*Tail* of the male chelated or clawed.

THE most familiar species of this genus is the *Panorpa communis* of Linnæus, an insect very frequently seen in meadows during the early part of summer. It is a longish-bodied fly, of moderate size, with four transparent wings, elegantly variegated with deep-brown spots: the tail of the male insect, which is generally carried in an upright position, is furnished with a forceps, somewhat in the manner of a lobster's claw.

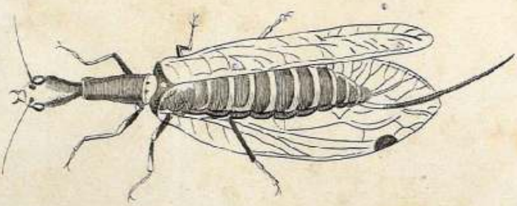
The *Panorpa Coa* is a native of Greece and the islands of the Archipelago, and is an insect of a very peculiar appearance. It is considerably larger than the preceding, and is distinguished by having the lower wings so extremely narrow or slender as to resemble a pair of linear processes with an oval dilatation at the tip, while the upper wings are very large, oval, transparent, and beautifully variegated with yellowish-brown bars and spots.



1805. Oct. 1 London. Published by G. Kearsley Fleet Street.

RAPHIDIA.

Ophiopsis



magnified

Heath sculp.

1805, Oct. 1 London Published by G. Kearsley Fleet Street

RAPHIDIA. RAPHIDIA.

Generic Character.

Os dentibus duobus in capite depresso corneo.

Palpi quatuor. *Stemmata* tria.

Alæ deflexæ.

Antennæ longitudine thoracis antice elongati cylindrici.

Cauda feminæ seta recurva laxa.

Mouth with two teeth: head depressed, horny.

Feelers four. *Stemmata* three.

Wings deflex.

Antennæ the length of thorax, which is cylindric, and elongated in front.

Tail of the female furnished with a recurved lax bristle.

THIS genus contains but few species, the most remarkable of which is the *Raphidia Ophiopsis* of Linnæus; a smallish fly, with rather large transparent wings, and a narrow thorax, stretching forwards in a remarkable manner. It is found on trees, &c. in summer, but is rather a rare insect: the pupa, according to Linnæus, resembles the complete insect, but is destitute of wings.

Raphidia cornuta is a large species, equal in size to one of the larger Dragon-Flies, and is distinguished by its very long, horn-like jaws, which extend far beyond the thorax, and are terminated

by a bifid tip: the wings are large, reticulated, and semitransparent. It is a native of North America.

Raphidia Mantispa is a small species, but little superior in size to the R. Ophiopsis, and is a native of some of the warmer parts of Europe. It has the habit of the genus Mantis, and it is even doubtful whether it should not more properly be referred to that genus than to the present.

INSECTS.

ORDER

HYMENOPTERA.

CYNIPS. CYNIPS.

Generic Character.

Os maxillis absque proboscide.	*Mouth* with jaws, but without proboscis.
Aculeus spiralis, sæpius reconditus.	*Piercer* or sting spiral, generally concealed.

THE insects of this genus pass their larva and chrysalis state in those enlargements or tubercles so common on various vegetables, and generally known by the name of Galls. These galls or swellings arise in consequence of the part on which they appear having been first punctured by

the female Cynips, which at the same time that she deposits her egg, discharges a peculiar fluid, which, by preventing the natural course of the sap, causes a gradual enlargement to take place.

Among the most remarkable of these vegetable excrescences may be ranked those produced on the leaves and footstalks of the Oak: these are well known in commerce under the name of Galls of Aleppo, the best or most efficacious being imported from the Turkish dominions. Those on the leaves of the oak are produced by the *Cynips Quercus folii* of Linnæus, a small short-bodied fly, of a blackish colour, with four transparent wings, carried in a flat direction over the back. In the month of July this animal punctures the leaves, depositing an ovum in each puncture, frequently to the number of six, seven, or eight on the same leaf. In the space of a few days so many small round swellings are produced: these towards the end of the month arrive at the size of common peas, but afterwards increase rapidly, till in the month of September they are arrived at the size of the largest of those represented on the annexed plate: at this period of their growth they are generally tinged with red, and marked by minute superficial tubercles. On slitting open a gall, the larva is found imbedded in the centre, in the form of a small white maggot, not ill resembling that of the common nut. In September it undergoes its change into chrysalis, in which state it continues about three weeks, when the complete insect

proceeds from it, gnawing its way through the gall. It however often remains during the whole winter in the gall, from which it issues in the succeeding spring. As a species this Cynips is particularly distinguished by having the upper surface of the thorax marked by several longitudinal black streaks, and a small dusky spot on the middle of each upper wing.

The *Cynips quercus petioli* of Linnæus is a species much allied to the preceding, but rather larger, and of a tawny-ferruginous cast, with the thorax marked also by black streaks. The gall produced by the puncture of this species is situated on the footstalks of oak leaves, and greatly resembles in size and appearance that of the former.

The *Cynips Rosæ* produces on the sweet-briar, dog-rose, &c. a gall of a highly singular appearance, resembling a beautiful heap of finely ramified moss, of a green colour tinged with red: this in the autumnal season is frequently observed, and when opened discovers in the solid fleshy or central part the included larva, in the form of a small white maggot, and sometimes several are found in different parts of the same mass. The Cynips itself is black, with ferruginous legs and abdomen, the latter tipped with black. The mossy gall above-mentioned, in which it is bred, is distinguished by the older writers on natural history by the title of *Bedeguar*.

The leaves of Willows are very frequently loaded by large, irregular, red swellings during the Sum-

mer. These are caused by the *Cynips viminalis* of Linnæus, a small species, of a yellow colour, with a black thorax. It is one of the most common of the genus, and affords one of the most familiar examples. It changes to chrysalis in the autumn, and lies in that state all winter in the fallen leaf, the perfect insect making its appearance in the succeeding spring.

With respect to the common Oak-Galls, a popular superstition has sometimes been entertained, that the great events of the ensuing year might be predicted by observing the prevailing animals found in their cavity, and the learned Sir Thomas Brown, in his Pseudodoxia Epidemica, has thought it worth his while, with much gravity, to explode this conceit; and it is curious to observe that this truly great man, while he successfully combats one popular error, falls himself into another, for want of that philosophical knowledge of Insects which later times have succeeded in obtaining.

" The presage of the year succeeding, which is commonly made from insects or little animals in Oak-Apples, according to the kinds thereof, either maggot, fly, or spider; that is of famine, war, or pestilence; whether we mean that woody excrescence which shooteth from the branch about May, or that round and apple-like accretion which groweth under the leaf about the latter end of summer, is, I doubt, too indistinct, nor verifiable from event. For flies and maggots are found

every year, very seldom spiders: and Helmont affirmeth he could never find the spider and the fly upon the same trees, that is the signs of war and pestilence, which often go together: beside that the flies found were at first maggots, experience hath informed us; for keeping these excrescencies, we have observed their conversions; beholding in magnifying-glasses the daily progression thereof; as may be also observed in other vegetable excretions, whose maggots do terminate in flies of constant shapes; as in the nutgalls of the outlandish oak, and the mossie tuft of the wild-briar; which having gathered in November, we have found the little maggots which lodged in wooden cells all winter, to turn into flies in June. We confess the opinion may hold some verity in analogy, or emblematical phancy; for pestilence is properly signified by the spider, whereof some kinds are of a very venomous nature: famine by maggots, which destroy the fruits of the earth; and war not improperly by the fly, if we rest in the phancy of Homer, who compares the valiant Grecian unto a fly. Some verity it may also have in itself; as truly declaring the corruptive constitution in the present sap and nutrimental juice of the tree; and may consequently discover the disposition of the year according to the plenty or kinds of those productions; for if the putrefying juices of bodies bring forth plenty of flies and maggots, they give forth testimony of common corruption, and declare that the elements are full

of the seeds of putrefaction, as the great number of caterpillars, gnats, and ordinary insects do also declare. If they run into spiders, they give signs of higher putrefaction, as plenty of vipers and scorpions are confessed to do; the putrefying materials producing animals of higher mischiefs according to the advance and higher strain of corruption."

TENTHREDO. TENTHREDO.

Generic Character.

Os maxillis absque probo-scide.	*Mouth* with jaws, without proboscis.
Alæ planæ, tumidæ.	*Wings* flat, swelled or slight-ly inflated.
Aculeus laminis duabus ser-ratis, vix prominentibus.	*Piercer* consisting of two serrated and scarcely pro-jecting laminæ.
Scutellum granis duobus im-positis distantibus.	*Scutellum* with two distant granules.

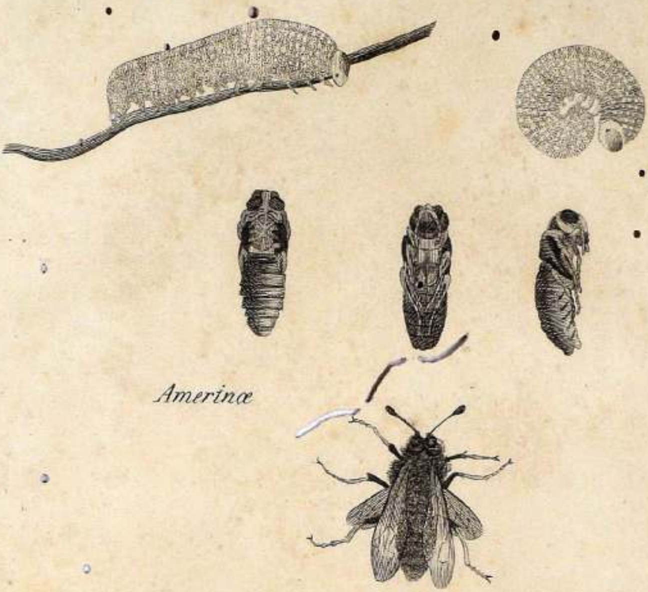
THE Larvæ of the genus Tenthredo are remarkable for their great resemblance to those of the order Lepidoptera or real caterpillars, from which however they may in general be readily distinguished by their more numerous feet, which are never fewer than sixteen, exclusive of the three first or thoracic pairs. When disturbed or handled they usually roll themselves into a flat spiral. They feed, like the caterpillars of the Lepidoptera, on the leaves of plants, and undergo their chrysalis state in a strong gummy case or envelopement, prepared in autumn, out of which in the ensuing spring emerges the complete insect.

The Tenthredines form a numerous genus, and may be divided into tribes or sections according

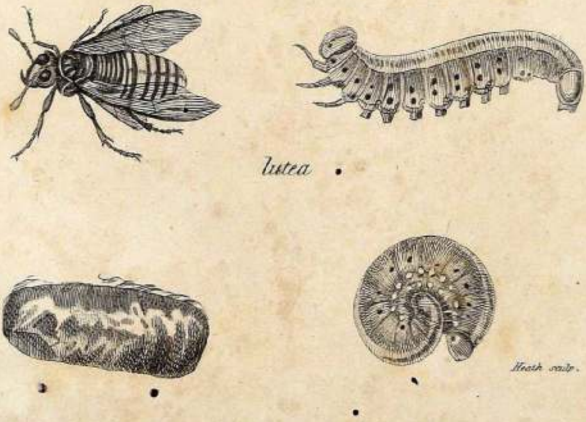
to the form of the antennæ, which are in some clavated, in others filiform, &c. Among the principal species may be numbered the Tenthredo lutea of Linnæus, which proceeds from a large green larva, of a finely granulated surface, with a double row of black specks along each side, and a dusky dorsal line bounded on each by yellow: it feeds on various species of willow, &c. the parchment-like case in which it envelops itself in autumn is of a pale yellowish brown colour, and the chrysalis, which is of a pale dusky or brownish cast, exhibits the limbs of the future fly, which is equal in size to a common wasp, and is of a yellow colour, barred with black: the antennæ rather short, and strongly clavated.

The *Tenthredo Amerinæ* of Linnæus is somewhat smaller than the preceding, and of a cinereous brown colour, with the under part of the abdomen rufous or dull orange: like the former, its caterpillar is of a green colour, and of a finely roughened surface powdered with numerous whitish specks.

The larvæ of the smaller Tenthredines are often very injurious to different kinds of esculent vegetables, as turnips, &c. &c.



Amerinæ

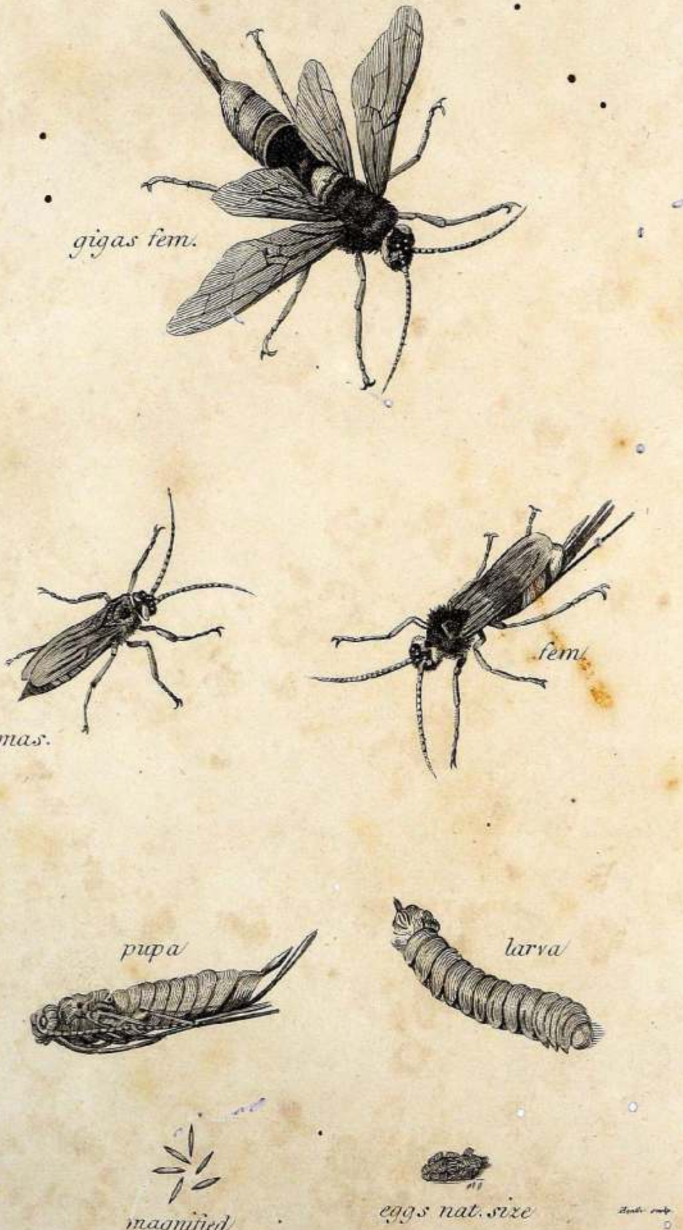


lutea

Heath sculp.

1805, Oct.r 1 London Published by G. Kearsley, Fleet Street

SIREX.



1805. Octr 1 London Published by G. Kearsley, Fleet Street.

SIREX. SIREX.

Generic Character.

Os maxillis duabus validis. Palpi duo, truncati.	*Mouth* with two strong jaws. Feelers two, truncated.
Antennæ filiformes; articulis ultra viginti quatuor.	*Antennæ* filiform, with more than twenty-four joints.
Aculeus exsertus, rigens, serratus.	*Piercer* exserted, stiff, serrated.
Abdomen sessile, mucronatum.	*Abdomen* sessile, pointed.
Alæ lanceolatæ, planæ omnibus.	*Wings* lanceolate, flat in all.

THE larvæ of these insects are of a lengthened, cylindric appearance, living in the decayed parts of trees, on the substance of which they feed: the chrysalis, as in the genus Tenthredo, exhibits the limbs of the perfect insect in a contracted state.

The largest species is the *Sirex Gigas* of Linnæus, which surpasses a hornet in size, and is principally observed in the neighbourhood of pines and other coniferous trees: it is of a black colour, with the eyes, the base, and lower half of the abdomen bright orange-yellow: the thorax villose, and the wings of a transparent yellowish brown: the sting or terminal tube is very conspicuous.

The larva, which measures about an inch and quarter in length, is of a yellowish white colour, and inhabits decayed firs and pines: at first view it bears some resemblance to the larvæ of the beetle tribe, but is thinner in proportion, and furnished at the tip of the abdomen with a short black spine or process. It changes to a chrysalis in July; first enveloping itself in a slight silken web of a whitish colour: the chrysalis is of a lengthened shape, with the antennæ, legs, and terminal tube or process very distinctly characterized. If the change to chrysalis takes place in summer, the fly proceeds from it in the space of about three weeks; but if at the close of autumn, the animal continues in chrysalis the whole winter, emerging in the following spring. The male insect is considerably smaller than the female, and may be farther distinguished by the want of the caudal tube or process, so conspicuous in the female insect: the tip of the abdomen is also of a black colour. The eggs, which are deposited by the female in the decayed parts of the trees above-mentioned, are very small, and of a lengthened oval shape with pointed extremities.

Sirex Columba is an American species, and is distinguished by its black body, marked by testaceous bands.

Sirex pygmæus is one of the smallest of the European species, being, according to Linnæus, about the size of a gnat, with a black abdomen, marked by three yellow bands, the middle of which is interrupted. It is found in Sweden.

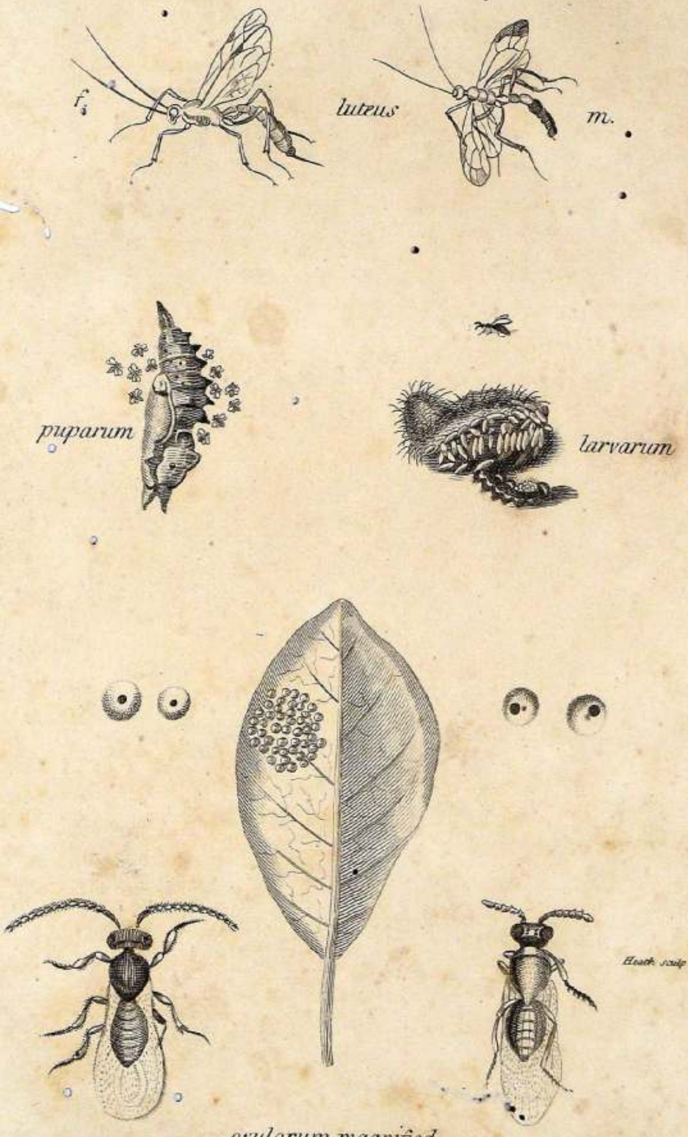
ICHNEUMON. ICHNEUMON.

Generic Character.

Os maxillis absque lingua.	*Mouth* with jaws, without tongue.
Antennæ articulis ultra triginta.	*Antennæ* with more than thirty joints.
Abdomen petiolatum plerisque.	*Abdomen* in most species footstalked.
Auleus exsertus, vagina cylindrica, bivalvi.	*Piercer* exserted, with a cylindric, bivalve sheath.

THE animals of this genus provide for the support of their offspring in a manner highly extraordinary; depositing their eggs in the bodies of other living insects, and generally in those of caterpillars. For this purpose the female Ichneumon, selecting her victim, and fastening upon it, pierces its skin with her abdominal tube, and introduces her eggs beneath the surface. In vain the tormented animal endeavours to evade this cruel operation: the Ichneumon maintains her hold, nor ceases till she has discharged her whole stock. These eggs in a few days hatch, and the young larvæ, which resemble minute white maggots, nourish themselves with the juices of the unfortunate animal, which however continues to move about and feed till near the time of its change

to chrysalis, when the young brood of Ichneumon-larvæ creep out by perforating the skin in various places, and each spinning itself up in a small oval silken case, changes into chrysalis, the whole number forming a groupe on the shrivelled body of the caterpillar which had afforded them nourishment; and, after a certain period, emerge in the state of complete Ichneumons. One of the most familiar examples of this process is afforded by the well-known caterpillar of the common white or cabbage butterfly, which, in the autumnal season may be frequently observed to creep up some wall or other convenient surface, in order to undergo its own change into chrysalis; but in the space of a day or two a numerous tribe of small maggots will be seen to emerge from it, and immediately proceed to envelop themselves in distinct yellow silken cases; the whole forming a groupe around the caterpillar. The Ichneumons proceeding from these are the species called by Linnæus *Ichneumon glomeratus:* their colour is black, with yellow legs: they usually make their appearance in about three weeks from the time of their spinning themselves up. Other small species of Ichneumon pierce the skins of newly changed chrysalises of butterflies and moths, in which their larvæ remain during their own incomplete state, as the *Ichneumon puparum* of Linnæus, a very small species, of a gilded green colour. Others again are so very small that the female pierces even the eggs of moths and butterflies, and deposits her own in each, as the *Ichneumon ovulorum*



ovulorum magnified

1805, Oct 1 London, Published by G. Kearsley, Fleet Street.

of Linnæus, one of the smallest of the whole tribe: it is of a black colour, with rufous legs, and long filiform antennæ.

Other Ichneumons are of very considerable size, and the females of these select some large caterpillar for their victim, as those of the larger Sphinges, such as the S. Ligustri, Convolvuli, &c. or one of the large and middle-sized Moths, as the Phalæna Vinula, Quercus, &c. &c. These large Ichneumons are generally bred in small numbers, and sometimes the female deposits but a single egg in the selected caterpillar. This may be instanced in the *Ichneumon ramidulus*, the larva of which is thus bred in the caterpillar of the Sphinx Ligustri: it is a very large Ichneumon, of a dull yellowish colour, with a cast of brown on the thorax, and with the antennæ and abdomen tipped with black: the abdomen is also of a falciform shape, curving downwards, and compressed on the sides. *Ichn: luteus* is a large species, nearly allied to the former, and of similar manners.

The seeming severity of the process ordained by Nature for giving birth to the genus Ichneumon, may be much diminished by supposing, (what all the ensuing phænomena seem to imply), that, after the first operation of piercing the skin and depositing the eggs is performed by the female Ichneumon, the caterpillar feels no acute pain; the included enemies feeding only on its juices, and evidently sparing the more important organs; so that it loses its life by a very gradual decay.

It was the want of an exact knowledge of the genus Ichneumon that proved so considerable an embarrassment to the older entomologists, who having seen a brood of Ichneumons proceed from the chrysalis of a Butterfly, could not but conclude that the production of insects was rather a variable and uncertain operation of Nature than a regular continuation of the same species. The observations however of Swammerdam, Malpighi, Roësel, and others have long since removed the difficulties which formerly obscured the history of the Insect tribe.

SPHEX.

viatica

spirifex

sabulosa

Heath. sculp.

1805, Oct.r 1. London. Published by G. Kearsley, Fleet Street.

SPHEX. SPHEX.

Generic Character.

Os maxillis absque lingua.	*Mouth* with jaws, without tongue.
Antennæ articulis decem.	*Antennæ* of ten joints.
Alæ plano-incumbentes (nec plicatæ) in omni sexu.	*Wings* flat-incumbent, (not pleated,) in each sex.
Aculeus punctorius reconditus.	*Sting* concealed.

As the Insects of the genus Ichneumon deposit their eggs in the bodies of other living insects, so those of the genus Sphex deposit theirs in dead ones, in order that the young larvæ, when hatched, may find their proper food. Thus the *Sphex figulus* of Linnæus, having found some convenient cavity for the purpose, seizes on a spider, and having killed it, deposits it at the bottom: then laying her egg in it, she closes up the orifice of the cavity with clay: the larva, which resembles the maggot of a bee, having devoured the spider, spins itself up in a dusky silken web, and changes into a chrysalis, out of which, within a certain number of days, proceeds the complete insect, which is of a black colour, with a slightly foot-stalked abdomen, the edges of the several seg-

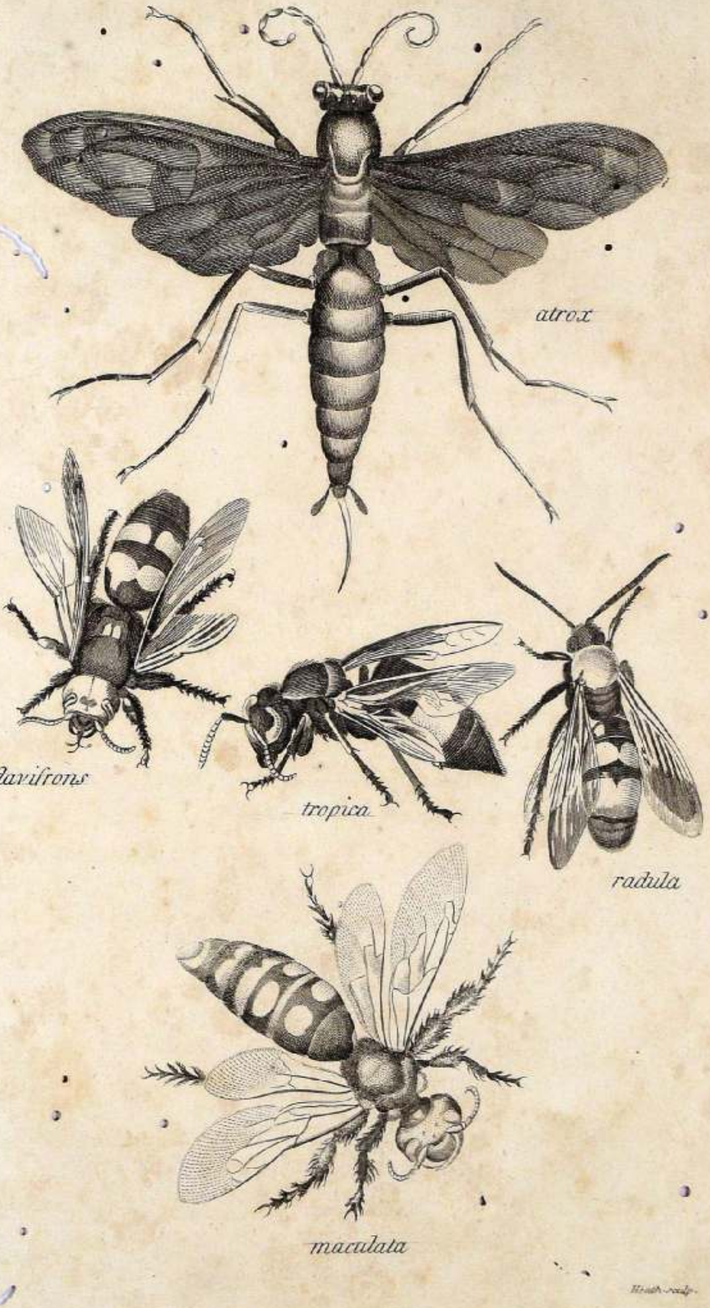
ments being of a brighter appearance than the rest of the body. It should be added, that the female of this species prepares several separate holes or nets as above-mentioned, in each of which she places a dead insect and an egg: each cell costing her the labour of about two days.

The *Sphex viatica* of Linnæus, which is of a black colour and slightly hairy, with brown wings, and the fore-part of the abdomen ferruginous with black bands, seizes caterpillars in a similar manner, burying one in every cell in which she deposits an egg, and then closes up the cell.

Sphex sabulosa Lin. is a black and hairy species, with the second and third joints of the abdomen ferruginous. It inhabits sandy and gravelly places, in which the female digs holes with her fore-feet, working in the manner of a dog, in order to form the cavity, in which she places either a spider or a caterpillar, after which she closes up the cavity, having first laid her egg in the dead insect. Linnæus in his description of this insect contradicts the generic character, since he observes that it has a retractile snout containing the tongue.

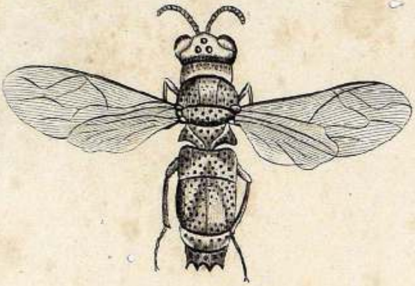
Many of the extra-European Spheges are insects of a very considerable size. The whole genus is very much allied to those of Vespa and Apis.

SPHEX.



Heath sculp.

1805 Oct. 1 London Published by G Kearsley Fleet Street.



ignita magnified

calens Fab

viridula Lin.

M. Griffith sculp.

1805, Oct.1 London, Published by G. Kearsley, Fleet Street

CHRYSIS. CHRYSIS.

Generic Character.

Os maxillis absque proboscide.	*Mouth* with jaws, without proboscis.
Antennæ filiformes, articulo primo longiore reliquis undecim brevibus.	*Antennæ* filiform, with the first joint lengthened, the remaining eleven short.
Abdomen subtus fornicatum, utrinque squama laterali.	*Abdomen* arched beneath, with a lateral scale on each side.
Anus dentatus aculeo subexserto.	*Vent* dentated: piercer subexserted.
Alæ planæ.	*Wings* flat.
Corpus auratum.	*Body* gilded.

THE beautiful genus Chrysis is, in general, distinguished by a peculiar brilliancy of colour. The most common British species is the *Chrysis ignita*, which may justly be considered as one of the most beautiful of the European insects. It is about the size of the common window fly, and is of a rich, deep, gilded blue-green colour on the head and thorax, with the abdomen of the most brilliant reddish gold-colour: the wings are brownish, and the legs blackish-green: the body is terminated by four denticulations. This insect is often seen in the middle of summer, and generally

in the hottest part of the day, flying about old walls, and breeding in the cavities which it prepares in them: its larva is said to resemble that of a Wasp.

Chrysis fulgida Lin. is very nearly allied to the preceding, but has the thorax and first segment of the abdomen blue, the remainder being of a gold-colour, and marked in a similar manner by four denticuli. These two species of Chrysis, as well as the rest of the genus, exhibit a highly beautiful appearance when magnified.

95

Head & trunk of V. vulgaris magnified.

signata

rostrata

rufa

parietum?

crabro

vulgaris

1805 Oct. 1 London Published by G. Kearsley. Fleet Street.

Heath sculp.

VESPA. WASP.

Generic Character.

Os maxillis, absque proboscide.	*Mouth* with jaws, without proboscis.
Alæ superiores plicatæ.	*Upper Wings* pleated.
Aculeus punctorius reconditus.	*Sting* concealed.
Oculi lunares.	*Eyes* lunated.
Corpus glabrum.	*Body* smooth.

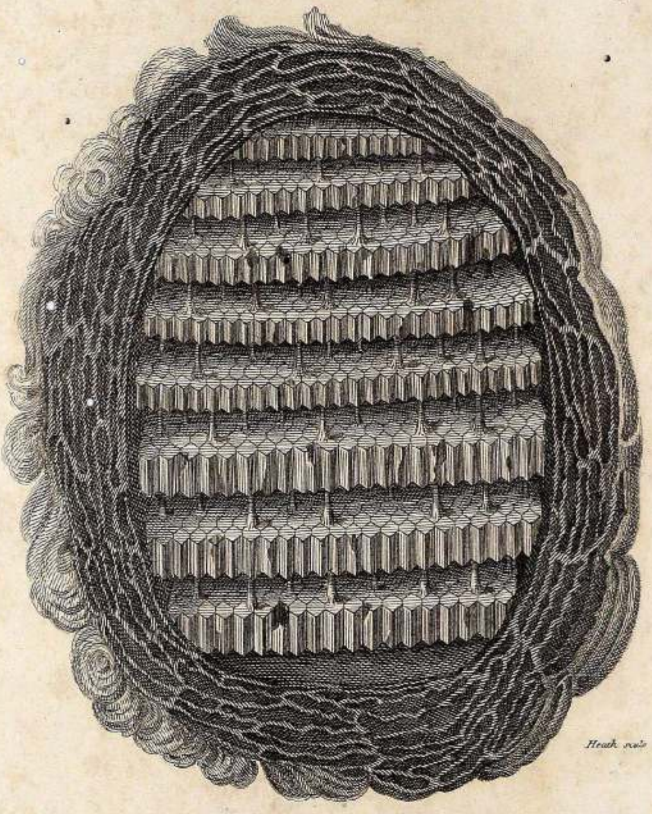
THE genus Vespa, is of great extent, and is remarkable, like that of Apis or Bee for the singular dexterity with which it constructs its habitation, which in many species is of considerable size. The *common Wasp* or *Vespa vulgaris** is known to every one. The nest of this species is a highly curious structure, and is prepared beneath the surface of some dry bank or other convenient situation: its shape is that of an upright oval, often measuring ten or twelve inches at least in diameter: it consists of several horizontal stages or stories of hexagonal cells, the interstices of each story being connected at intervals by up-

* Perhaps not the Vespa vulgaris of Linnæus, which he represents as building its nest under projecting roofs, &c. whereas the common English wasp builds its nest under ground.

right pillars, and the exterior surface of the nest consists of a great many layers or pieces, disposed over each other in such a manner as best to secure the interior cavity from the effects of cold and moisture: the whole nest, comprizing both walls and cells, is composed of a substance very much resembling the coarser kinds of whitish-brown paper, and consists of the fibres of various dry vegetable substances, agglutinated by a tenacious fluid discharged from the mouths of the insects during their operations. The female Wasps deposit their eggs in the cells, one in each cell appropriated for that purpose: from these are hatched the larvæ or maggots, which bear a near resemblance to those of Bees: they are fed by the labouring wasps with a coarse kind of honey, and, when arrived at their full size, close up their respective cells with a fine tissue of silken filaments, and, after a certain period, emerge in their complete or perfect form. The male insect, like the male Bee, is destitute of a sting. The society or swarm of the common Wasp consists of a vast number of neutral or labouring insects, a much smaller number of males, still fewer females. They do not, like Bees, prepare and lay up a store of honey for winter use, but the few which survive the season of their birth remain torpid during the colder months. Wasps in general are both carnivorous and frugivorous.

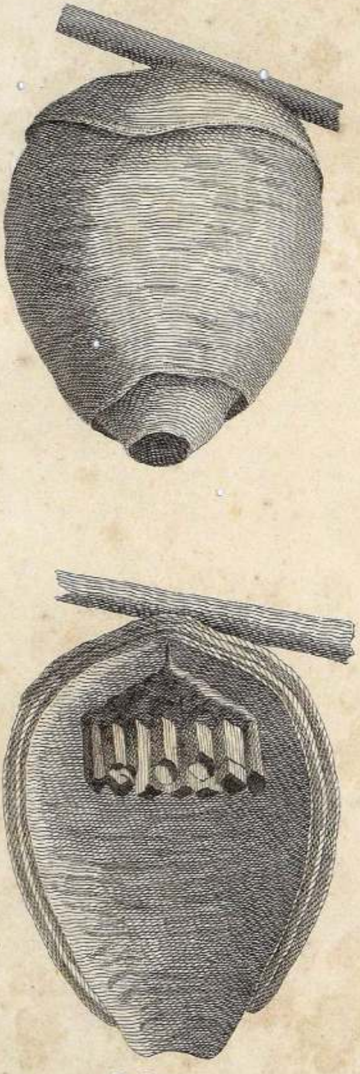
The *Hornet*, *Vespa Crabro* of Linnæus is a species of a far more formidable nature than the common Wasp, and is of considerably larger size:

VESPA.



Wasp's Nest about a 4th of the natural size.

1805. Octr 1 London, Published by G Kearsley, Fleet Street.



V. holsatica with views of the nest

Heath

1805. Oct.r 1 London Published by G. Kearsley Fleet Street.

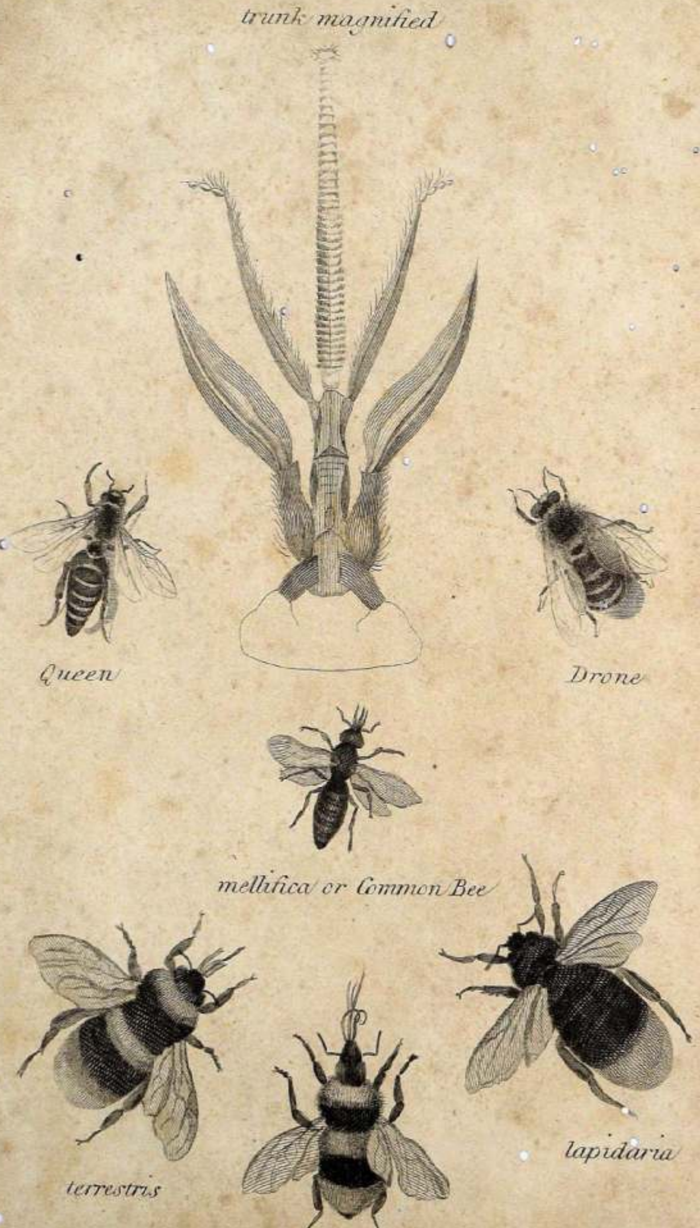
its colour is a tawny yellow with ferruginous and black bars and variegations. The nest of this species is generally built in the cavity of some decayed tree, or immediately beneath its roots; and not unfrequently in timber-yards and other similar situations. It is of smaller size than that of the Wasp, and of a somewhat globular form, with an opening beneath; the exterior shell consisting of more or fewer layers of the same strong paper-like substance with that prepared by the Wasp: the cells are also of a similar nature, but much fewer in number, and less elegantly composed. The hornet, like the Wasp, is extremely voracious, and preys on almost any kind of fresh animal substances which it can obtain, as well as on honey, fruit, &c. &c. Its sting is greatly to be dreaded, and is often productive of very serious consequences.

A highly elegant Wasp's-Nest is sometimes seen during the summer season, attached or hanging as it were by its base to some straw or other projecting substance, from the upper part of unfrequented buildings or outhouses. It does not much exceed the size of an egg, but is of a more globular form, and consists of several concentric bells, with considerable intervals between each, the interior alone being entire, and furnished with a small round orifice; the rest reaching only about two thirds from the base of the nest. In the centre of the complete or entire bell is situated the congeries of cells, built round a small central pillar attached to the base: the cells are not

very numerous, and their orifices look downwards. This nest is attributed by Monsr. Latreille, in the work entitled "Annales du Museum National d'Histoire Naturelle," No. 4. to the Vespa Holsatica of Fabricius, and appears to be found both in England and France, as well as in many other parts of Europe.

I may here observe that much remains to be done with respect to the investigation of species in this extensive genus, and there is great reason to suspect that much confusion at present takes place in their history.

APIS.



1805, Oct 1 London. Published by G. Kearsley, Fleet Street.

APIS. BEE.

Generic Character.

Os maxillis atque proboscide inflexa vaginis duabus bivalvibus.	*Mouth* furnished with jaws and an inflected proboscis with two bivalve sheaths.
Alæ planæ.	*Wings* flat, or without plaits.
Aculeus feminis et neutris punctorius, reconditus.	*Sting* in the female and neutral insects, concealed.

THIS genus, which, like the preceding, is of very considerable extent, is distributed by Linnæus into two assortments, viz. those in which the body of the animal is but slightly covered with fine hair or down, and those in which it is remarkably villose or hairy: the insects of the latter division are commonly distinguished by the title of Humble-Bees.

In the first division the chief or most important species is the *Apis mellifica* or common honey-bee, so long and justly celebrated for its wonderful polity, the neatness and precision with which it constructs its cells, and the diligence with which it provides during the warmth of summer a supply of food for the support of the hive during the rigours of the succeeding winter. The general

history of this interesting insect has been amply detailed by various authors, as Swammerdam, Reaumur, &c. &c. Among the most elaborate accounts of later times may be numbered that of Mr. John Hunter, which makes its appearance in the Philosophical Transactions for the year 1792. This paper I shall beg leave to introduce, with a few occasional variations and abridgements, into the present work.

"There are three periods at which the history of the bee may commence: first, in the spring, when the queen begins to lay her eggs; in the summer, at the commencement of a new colony; or in the autumn, when they are going into winter-quarters. I shall begin the particular history of the bee with the new colony, when nothing is formed; for it begins then every thing that can possibly happen afterwards.

"When a hive sends off a colony, it is commonly in the month of June, but that will vary according to the season, for in a mild spring bees sometimes swarm in the middle of May, and very often at the latter end of it. Before they come off, they commonly hang about the mouth of the hole, or door of the hive, for some days, as if they had not sufficient room within for such hot weather, which I believe is very much the case; for if cold or wet weather come on, they stow themselves very well, and wait for fine weather. But swarming appears to be rather an operation arising from necessity, for they would seem not naturally to swarm, because if they have an empty space to

fill, they do not swarm; therefore by increasing the size of the hive, the swarming is prevented. This period is much longer in some than in others. For some evenings before they come off, is often heard a singular noise, a kind of ring, or sound of a small trumpet; by comparing it with the notes of the piano-forte, it seemed to be the same sound with the lower A of the treble.

"The swarm commonly consists of three classes; a female, or females*, males, and those commonly called mules, which are supposed to be of no sex, and are the labourers; the whole about two quarts in bulk, making about six or seven thousand. It is a question that cannot easily be determined, whether this old stock sends off entirely young of the same season, and whether the whole of their young ones, or only part. As the males are entirely bred in the same season, part go off; but part must stay, and most probably it is so with the others. They commonly come off in the heat of the day, often immediately after a shower; who takes the lead I do not know, but should suppose it was the queen. When one goes off, they all immediately follow, and fly about seemingly in great confusion, although there is one principle actuating the whole. They soon appear to be directed to some fixed place; such as the branch of a tree or bush, the cavities of old trees, holes of houses leading into some hollow place; and when-

* "I have reason to believe that never more than one female comes off with a swarm."

ever the stand is made, they all immediately repair to it, till they are all collected. But it would seem, in some cases, that they had not fixed upon any resting place before they came off, or if they had, that they were either disturbed, if it was near, or that it was at a great distance; for, after hovering some time, as if undetermined, they fly away, mount up into the air, and go off with great velocity. When they have fixed upon their future habitation, they immediately begin to make their combs, for they have the materials within themselves. I have reason to believe that they fill their crops with honey when they come away; probably from the stock in the hive. I killed several of those that came away, and found their crops full, while those that remained in the hive had their crops not near so full: some of them came away with farina on their legs, which I conceive to be rather accidental. I may just observe here, that a hive commonly sends off two, sometimes three swarms in a summer; but that the second is commonly less than the first, and the third less than the second; and this last has seldom time to provide for the winter: they shall often threaten to swarm, but do not; whether the threatening is owing to too many bees, and their not swarming is owing to there being no queen, I do not know. It sometimes happens that the swarm shall go back again; but in such instances I have reason to think that they have lost their queen, for the hives to which their swarm have come back do not swarm the next warm day, but shall hang out

for a fortnight, or more, and then swarm; and when they do, the swarm is commonly much larger than before, which makes me suspect that they waited for the queen that was to have gone off with the next swarm.

"So far we have set the colony in motion. The materials of their dwelling, or comb, which is the wax, is the next consideration, with the mode of forming, preparing, or disposing of it. In giving a totally new account of the wax, I shall first show it can hardly be what it has been supposed to be. First, I shall observe that the materials, as they are found composing the comb, are not to be found in the same state (as a composition) in any vegetable, where they have been supposed to be got. The substance brought in on their legs, which is the farina of the flowers of plants, is, in common, I believe, imagined to be the materials of which the wax is made, for it is called by most the wax: but it is the farina, for it is always of the same colour as the farina of the flower where they are gathering; and indeed we see them gathering it, and we also see them covered almost all over with it, like a dust; nevertheless, it has been supposed to be the wax, or that the wax was extracted from it. Reaumur is of this opinion. I made several experiments to see if there was such a quantity of oil in it, as would account for the quantity of wax to be formed, and to learn if it was composed of oil. I held it near the candle; it burnt, but did not smell like wax, and had the same smell, when burning, as farina

when it was burnt. I observed that this substance was of different colours on different bees, but always of the same colour on both legs of the same bee; whereas new made comb was all of one colour. I observed, that it was gathered with more avidity for old hives, where the comb is complete, than for those hives where it is only begun, which we could hardly conceive if it was the materials of wax: also we may observe, that at the very beginning of a hive, the bees seldom bring in any substance on their legs for two or three days, and after that the farina gatherers begin to increase; for now some cells are formed to hold it as a store, and some eggs are laid, which when hatched will require this substance as food, and which will be ready when the weather is wet. I have also observed, that when the weather has either been so cold, or so wet, in June, as to hinder a young swarm from going abroad, they have yet in that time formed as much new comb, as they did in the same time when the weather was such as allowed them to go abroad. I have seen them bring it in about the latter end of March, and have observed, in glass hives, the bees with the farina on their legs, and have seen them disposing of it, as will be described hereafter.

"The wax is formed by the bees themselves; it may be called an external secretion of oil, and I have found that it is formed between each scale of the under side of the belly. When I first observed this substance, in my examination of the

working bee, I was at a loss to say what it was: I asked myself if it was new scales forming, and whether they cast the old, as the lobster, &c. does? but it was to be found only between the scales, on the lower side of the belly. On examining the bees through glass hives, while they were climbing up the glass, I could see that most of them had this substance, for it looked as if the lower, or posterior edge of the scale, was double, or that there were double scales: but I perceived it was loose, not attached. Finding that the substance brought in on their legs was farina, intended, as appeared from every circumstance, to be the food of the maggot, and not to make wax; and not having yet perceived any thing that could give me the least idea of wax; I conceived these scales might be it, at least I thought it necessary to investigate them. I therefore took several on the point of a needle, and held them to a candle, where they melted, and immediately formed themselves into a round globe; upon which I no longer doubted but this was the wax, which opinion was confirmed to me by not finding those scales but in the building season. In the bottom of the hive we see a good many of the scales lying loose, some pretty perfect, others in pieces. I have endeavoured to catch them, either taking this matter out of themselves, from between the scales of the abdomen, or from one another, but never could satisfy myself in this respect: however, I once caught a bee examining between the scales of the belly of another, but I could not find

that it took any thing from between. We very often see some of the bees wagging their belly, as if tickled, running round, and to and fro, for only a little way, followed by one or two other bees, as if examining them. I conceived they were probably shaking out the scales of wax, and that the others were ready upon the watch to catch them, but I could not absolutely determine what they did. It is with these scales that they form the cells called the comb, but perhaps not entirely, for, I believe, they mix farina with it; however, this only occasionally, when probably the secretion is not in great plenty. I have some reason to think, that where no other substance is introduced, the thickness of the scale is the same with that of the sides of the comb; if so, then a comb may be no more than a number of these united; but a great deal of the comb seems to be too thick for this, and, indeed, would appear to be a mixture, similar to the covering of the chrysalis. The wax naturally is white, but when melted from the comb at large, it is yellow. I apprehended this might arise from its being stained with honey, the excrement of the maggots, and with the bee-bread. I steeped some white comb in honey, boiled some with farina, as also with old comb, but I could not say that it was made yellower. Wax, by bleaching, is brought back to its natural colour, which is also a proof that its colour is derived from some mixture. I have reason to believe that they take the old comb, when either broken down, or by any accident rendered

useless, and employ it again; but this can only be with combs that have had no bees hatched in them, for the wax cannot be separated from the silk afterwards. Reaumur supposed that they new worked up the old materials, because he found the covering of the chrysalis of a yellower colour than the other parts of the new comb; but this is always so, whether they have old yellow comb to work up, or not, as will be shewn.

"The bees who gather the farina also form the wax, for I found it between their scales.

"The cells, or rather the congeries of cells, which compose the comb, may be said to form perpendicular plates, or partitions, which extend from top to bottom of the cavity in which they build them, and from side to side. They always begin at the top, or roof of the vault, in which they build, and work downwards; but if the upper part of this vault, to which their combs are fixed, is removed, and a dome is put over, they begin at the upper edge of the old comb, and work up into the new cavity at the top. They generally may be guided as to the direction of their new plates of comb, by forming ridges at top, to which they begin to attach their comb. In a long hive, if these ridges are longitudinal, their plates of comb will be longitudinal; if placed transverse, so will be the plates; and if oblique, the plates of comb will be oblique. Each plate consists of a double set of cells, whose bottoms form the partition between each set. The plates themselves are not very regularly arranged, not forming a regular

plane where they might have done so; but are often adapted to the situation, or shape of the cavity in which they are built. The bees do not endeavour to shape their cavity to their work, as the wasps do, nor are the cells of equal depths, also fitting them to their situation; but as the breeding cells must all be of a given depth, they reserve a sufficient number for breeding in, and they put the honey into the others, as also into the shallow ones. The attachment of the comb round the cavity is not continued, but interrupted, so as to form passages; there are also passages in the middle of the plates, especially if there be a cross stick to support the comb; these allow of bees to go across from plate to plate. The substance which they use for attaching their combs to surrounding parts is not the same as the common wax; it is softer and tougher, a good deal like the substance with which they cover in their chrysalis, or the humble bee surrounds her eggs. It is probably a mixture of wax with farina. The cells are placed nearly horizontally, but not exactly so; the mouth raised a little, which probably may be to retain the honey the better; however this rule is not strictly observed, for often they are horizontal, and towards the lower edge of a plane of comb they are often declining. The first combs that a hive forms are the smallest, and much neater than the last, or lowermost. Their sides, or partitions between cell and cell, are much thinner, and the hexagon is much more perfect. The wax is purer, being probably little

else but wax, and it is more brittle. The lower combs are considerably larger, and contain much more wax, or perhaps, more properly, more materials; and the cells are at such distances as to allow them to be of a round figure: the wax is softer, and there is something mixed with it. I have observed that the cells are not all of equal size, some being a degree larger than the others; and that the small are the first formed, and of course at the upper part, where the bees begin, and the larger are nearer the lower part of the comb, or last made: however, in hives of particular construction, where the bees may begin to work at one end, and can work both down, and towards the other end, we often find the larger cells both on the lower part of the combs, and also at the opposite end. These are formed for the males to be bred in; and in the hornets and wasps combs, there are larger cells for the queens to be bred in: these are also formed in the lower tier, and the last formed.

"The first comb made in a hive is all of one colour, viz. almost white; but is not so white towards the end of the season, having then more of a yellow cast.

"*Of the Royal Cell.*

"There is a cell, which is called the Royal Cell, often three or four of them, sometimes more; I

have seen eleven, and even thirteen in the same hive; commonly they are placed on the edge of one or more of the combs, but often on the side of a comb; however, not in the centre, along with the other cells, like a large one placed among the others, but often against the mouths of the cells, and projecting out beyond the common surface of the comb; but most of them are formed from the edge of the comb, which terminates in one of these cells. The royal cell is much wider than the others, but seldom so deep: its mouth is round, and appears to be the largest half of an oval in depth, and is declining downwards, instead of being horizontal or lateral. The materials of which it is composed are softer than common wax, rather like the last mentioned, or those of which the lower edge of the plate of comb is made, or with which the bees cover the chrysalis: they have very little wax in their composition, not one third, the rest I conceive to be farina.

"This is supposed to be the cell in which the queen is bred, but I have reason to believe that this is only imagination: for, first, it is too large, and, moreover, seldom so deep as the large cells in which the males are bred; whereas, if proportioned to the length of the queen, it ought to be deeper, for length of body is her greatest difference. In the second place, its mouth is placed downward; and in the third place, it is never lined with the silken covering of the chrysalis, similar to the cells of the males and labourers;

nor do we find excrement at the bottom of it. The number of these cells is very different, in different hives. I think I have seen hives without any, and I have seen them with eleven or twelve, sometimes more. I have examined them at all times through the summer, but never found any alteration in them.

"The comb seems at first to be formed for propagation, and the reception of honey to be only a secondary use; for if the bees lose their queen, they make no combs; and the wasp, hornet, &c. make combs, although they collect no honey; and the humble bee collects honey, and deposits it in cells she never made.

"I shall not consider the bee as an excellent mathematician, capable of making exact forms, and having reasoned upon the best shape of the cell for capacity, so that the greatest number might be put into the smallest space (for the hornet and the wasp are much more correct, although not seemingly under the same necessity, as they collect nothing to occupy their cells); because, although the bee is pretty perfect in these respects, yet it is very incorrect in others, in the formation of the comb: nor shall I consider these animals as forming comb of certain shape and size, from mere mechanical necessity, as from working round themselves; for such a mould would not form cells of different sizes, much less could wasps be guided by the same principle, as their cells are of very different sizes, and the first by much soo small for the queen wasp to have worked

round herself: but I shall consider the whole as an instinctive principle, in which the animal has no power of variation, or choice, but such as arises from what may be called external necessity. The cell has in common six sides, but this is most correct in those first formed; and their bottom is commonly composed of those sides, or planes, two of the sides making one; and they generally fall in between the bottoms of three cells of the opposite side; but this is not regular, it is only to be found where there is no external interruption.

"I have already observed, that the last formed cells in the season are not so well made: that their partitions are thicker, and more of a yellow colour: this arises, I imagine, from the wax being less pure, having more alloy in it; and therefore, not being so strong, more of it is required. The bees would appear to reserve many of their cells for honey, and those are mostly at the upper part. In old hives, of several years standing, I have found the upper part of the comb free from the consequences of having bred, such as the silk lining, and the excrement of the maggots at the bottom; while the lower part, for probably more than one half of the plane of cells, shewed strong marks of having contained many broods of young bees. In such the lining of silk is thick at the sides, composed of many laminæ; and in many, the bottom is half filled up with excrement; and I observed at such parts, the comb was thickest at its mouth; which inclines me to think, that when a cell becomes shallow, by the bottom being in

some degree filled up, the bees then add to its mouth. Such also they seem to reserve principally for the bee-bread; so that to lay up a greater store of honey is an object to them.

"

" *Of the Laying of Eggs.*

" As soon as a few combs are formed, the female bee begins laying of eggs. As far as I have been able to observe, the queen is the only bee that propagates, although it is asserted that the labourers do. Her first eggs in the season are those which produce labourers; then the males, and probably the queen; this is the progress in the wasp, hornet, humble bee, &c. However, it is asserted by Riem, that when a hive is deprived of a queen, labourers lay eggs; also, that at this time, some honey and farina are brought in, as store for a wet day. The eggs are laid at the bottom of the cell, and we find them there before the cells are half completed, so that propagation begins early and goes on along with the formation of the other cells. The egg is attached at one end to the bottom of the cell, sometimes standing perpendicularly, often obliquely; it has a glutinous, or slimy covering, which makes it stick to any thing it touches. It would appear that there was a period or periods for laying eggs; for I have observed in a new swarm, that the great business of laying eggs did not last above a fortnight; although the hive was not half

filled with comb, it began to slacken. Probably that end of the egg which is first protruded, is that which sticks to the bottom of the cell: and probably the tail of the maggot is formed at that end: when they move the egg, how they make it stick again, I do not know. I have just observed, that they often move the egg out of a cell, to some other, we may suppose; why they do this, I cannot say; whether it is because we have been exposing this part, is not easily determined. In those new formed combs, as also in many not half finished, we find the substance called bee-bread, and some of it is covered over with wax; which will be considered further. By the time they have worked above half way down the hive, with the comb, they are beginning to form the larger cells, and by this time the first broods are hatched, which were small, or labourers; and now they begin to breed males, and probably a queen, for a new swarm; because the males are now bred to impregnate the young queen for the present summer, as also for the next year. This progress in breeding is the same with that of the wasp, hornet, and humble bee*. Although *this account* is commonly allowed, yet writers on this subject have supposed another mode of producing a queen,

* "Reaumur on Bees, says, that the drone eggs, when laid in small cells, produce drones: and Wilhelmi says, that it is the labourers only that lay drones eggs. Mr. Riem says, that queens are never reared in any but royal cells, although males sometimes in common cells; and workers in old queen cells, but never in those recently made."

when the hive is in possession of maggots, and deprived of their queen.

"What may be called the complete process of the egg, namely, from the time of laying to the birth of the bee, (that is, the time of hatching,) the life of the maggot, and the life of the chrysalis, is, I believe, shorter than in most insects. It is not easy to fix the time when the eggs hatch: I have been led to imagine it was in five days. When they hatch, we find the young maggot lying coiled up in the bottom of the cell, in some degree surrounded with a transparent fluid. In many of the cells, where the eggs have just hatched, we find the skin standing in its place, either not yet removed, or not pressed down by the maggot. There is now an additional employment for the labourers, namely, the feeding and nursing the young maggots. We may suppose the queen has nothing to do with this, as there are at all times labourers enough in the hive for such purposes, especially too, as she never does bring the materials, as every other of the tribe is obliged to do at first; therefore she seems to be a queen by hereditary, or rather, by natural right, while the humble bee, wasp, hornet, &c. seem rather to work themselves into royalty, or mistresses of the community. The bees are readily detected feeding the young maggot; and indeed a young maggot might easily be brought up, by any person who would be attentive to feed it. They open their two lateral pincers to receive the food, and swallow it. As they grow, they cast their coats,

or cuticles; but how often they throw their coats, while in the maggot state, I do not know. I observed that they often removed their eggs; I also find they very often shift the maggot into another cell, even when very large. The maggots grow larger and larger till they nearly fill the cell; and by this time they require no more food, and are ready to be inclosed for the chrysalis state: how this period is discovered I do not know, for in every other insect, as far as I am acquainted, it is an operation of the maggot, or caterpillar itself; but in the common bee, it is an operation of the perfect animal; probably it arises from the maggot refusing food. The time between their being hatched and their being inclosed is, I believe, four days; at least, from repeated observations, it comes nearly to that time: when ready for the chrysalis state, the bees cover over the mouth of the cell, with a substance of a light brown colour, much in the same manner that they cover the honey, excepting that, in the present instance, the covering is convex externally, and appears not to be entirely wax, but a mixture of wax and farina. The maggot is now perfectly inclosed, and it begins to line the cell and covering of the mouth above mentioned, with a silk it spins out similar to the silk-worm, and which makes a kind of pod for the chrysalis. Bonnet observed, that, in one instance, the cell was too short for the chrysalis, and it broke its covering, and formed its pod higher, or more convex than common: this I can conceive possible: we often

see it in the wasp. Having completed this lining, they cast off, or rather shove off, from the head backwards, the last maggot coat, which is deposited at the bottom of the cell, and then they become chrysalises.

"*Of the Food of the Maggot, or what is commonly called Bee-Bread.*

"One would naturally suppose, that the food of the maggot bee should be honey, both because it is the food of the old ones, and it is what they appear principally to collect for themselves; however, the circumstance of honey being food for the old ones is no argument, because very few young animals live on the same food with the old, and therefore it is probable the maggot bee does not live upon honey; and if we reason from analogy, we shall be led to suppose the bee-bread to be the food of the maggot. It is the food of the maggot of the humble bee, who feeds upon honey, and even lays up a store of honey for a wet day, yet does not feed the young with it. It is the food of the maggot of a black bee, and also of several others of the solitary kind, who also feed upon honey; and wasps, &c. who do not bring in such materials, do not feed themselves upon honey. We cannot suppose, that the bee-bread is for the food of the old bees, when we see them collecting it in the months of June, July, &c. at which time they have honey in great plenty. This substance

is as common to a hive as any part belonging to the œconomy of bees. Before they have formed five or six square inches of comb in a young hive, we shall find eggs, honey, and bee-bread; and at whatever time of the year we kill a hive, we shall find this substance; and if a hive is short of honey, and dies in the winter, we find no honey, but all the bee-bread, which was laid up in store for the maggots in the spring. They take great care of it, for it is often covered over with wax, as the honey, and I believe more especially in the winter; probably with a view to preserve it till wanted. In April I have found some of the cells full, others only half full. If we slit down a cell filled with this substance, we shall commonly find it composed of layers of different colours; some a deep orange, others a pale brown. In glass hives, we often find that the glass makes one side of the cell, and frequently in such we shall see at once the different strata above mentioned. This is the substance which they bring in on their legs, and consists of the farina of plants. It is not the farina of every plant that the bee collects, at least they are found gathering it from some with great industry, while we never find them on others: St. John's wort is a favourite plant, but that comes late. The flower of the gourd, cucumber, &c. they seem to be fond of. What they do collect must be the very loose stuff, just ready to be blown off to impregnate the female part of the flower; and to show that this is the case, we find bees impregnate flowers that have not the male

part. It is in common of a yellow colour, but that of very different shades, often of an orange; and when we see bees collecting it on bushes that have a great many flowers, so as to furnish a complete load, it is then of the colour of the farina of that bush. It is curious to see them deposite this substance in the cell. On viewing the hives, we often see bees with this substance on their legs, moving along on the combs, as if looking out for the cell to deposite it in. They will often walk over a cell that has some deposited in it, but shall leave that, and try another, and so on till they fix; which made me conceive that each bee had its own cell. When they come to the intended cell, they put their two hind legs into it, with the two fore legs and the trunk out on the mouth of the neighbouring cell, and then the tail, or belly, is thrust down into the intended cell; they then bring the leg under the belly, and turning the point of the tail to the outside of the leg, where the farina is, they shove it off by the point of the tail. When it is thus shoved off both legs, the bee leaves it, and the two pieces of farina may be seen lying at the bottom of the cell: another bee comes almost immediately, and creeping into the cell, continues about five minutes, kneading and working it down into the bottom, or spreads it over what was deposited there before, leaving it a smooth surface.

"It is of a consistency like paste; burns slightly, and gives a kind of unusual smell, probably from having been mixed with animal juice in the act of

kneading it down; for when brought in, it is rather a powder than a paste. That it is the food of the maggot is proved by examining the animal's stomach; for when we kill a maggot full grown, we find its stomach full of a similar substance, only softer, as if mixed with a fluid, but we never find honey in the stomach; therefore we are to suppose it is collected as food for the maggot, as much as honey is for the old bee. The food of the male and the queen maggot has been supposed to be different from that of the labourers. Reaumur says, the food of the queen maggot is different in taste from that of the common ones. How he knew this, who was unacquainted with the food of the others, I cannot conceive.

" *Of the Excrement of the Maggot.*

" They have very little excrement, but what they do discharge is deposited at the bottom of the cell; and what at first will appear rather extraordinary, it is never cleared away by the bees, but allowed to dry along with the maggot coats; and both fresh eggs and honey are deposited in these cells, so circumstanced, every future year; so that in time the cells become nearly half full.

" *Of the Chrysalis State.*

" In this state they are forming themselves for a new life: they are either entirely new built, or

wonderfully changed, for there is not the smallest vestige of the old form remaining; yet it must be the same materials, for now nothing is taken in. How far this change is only the old parts new modelled, or gradually altering their form, is not easily determined. To bring about the change, many parts must be removed, out of which the new ones are probably formed. As bees are not different in this state from the common flying insects in general, I shall not pursue the subject of their changes further; although it makes a very material part in the natural history of insects.

"When the chrysalis is formed into the complete bee, it then destroys the covering of its cell, and comes forth. The time it continues in this state is easier ascertained than either in that of the egg, or the maggot; for the bees cannot move the chrysalis, as they do the two others. In one instance it was thirteen days and twelve hours exactly; so that an egg in hatching being five days, the age of the maggot being four days, and the chrysalis continuing thirteen and a half, the whole makes twenty-two days and a half: but how far this is accurate, I will not pretend to say. I found that the chrysalis of a male was fourteen days, but this was probably accidental. When they first come out, they are of a greyish colour, but soon turn brown.

"When the swarm of which I have hitherto been giving the history has come off early, and is a large one, more especially if it was put into too small a hive, it often breeds too many for the hive

to keep through the winter; and in such case a new swarm is thrown off, which, however, is commonly not a large one, and generally has too little time to complete its comb, and store it with honey sufficient to preserve them through the winter. This is similar to the second or third swarm of the old hives.

" *Of the Seasons, when the different Operations of Bees take place.*

" I have already observed, that the new colony immediately sets about the increase of their numbers, and every thing relating to it. They had their apartments to build, both for the purpose of breeding, and as a storehouse for provisions for the winter. When the season for laying eggs is over, then is the season for collecting honey; therefore, when the last chrysalis for the season comes forth, its cell is immediately filled with honey, and as soon as a cell is full, it is covered over with pure wax, and is to be considered as store for the winter. This covering answers two very essential purposes: one is to keep it from spilling, or daubing the bees: the other to prevent its evaporation, by which means it is kept fluid in such a warmth. They are also employed in laying up a store of bee-bread for the young maggots in the spring, for they begin to bring forth much earlier than probably any other insect, because they retain a summer heat, and store up food for the young.

"In the month of August we may suppose the queen, or queens, are impregnated by the males; and as the males do not provide for themselves, they become burdensome to the workers, and are therefore teased to death much sooner than they otherwise would die; and when the bees set about this business, of providing their winter store, every operation is over, except the collecting of honey and bee-bread. At this time it would seem as if the males were conscious of their danger, for they do not rest on the mouth of the hive in either going out or coming in, but hurry either in or out: however they are commonly attacked by one, two, or three at a time: they seem to make no resistance, only getting away as fast as possible. The labourers do not sting them, only pinch them, and pull them about as if to wear them out; but I suspect it may be called as much a natural, as a violent death.

"The whole of the males are now destroyed, and indeed it would have been useless to have saved any to impregnate the queen in the spring. That there may be many more than may be wanted, I can easily believe, for this we see throughout nature; but she always times her operations well, although there may be supernumeraries.

"When the young are wholly come forth, and either the cells entirely filled, or no more honey to be collected, then is the time, or season, for remaining in their hives for the winter.

"Although I have now completed a hive, and

no operations are going on in the winter months, yet the history of this hive is imperfect till it sends forth a new swarm.

"As the common bee is very susceptible of cold, we find as soon as the cold weather sets in, they become very quiet, or still, and remain so throughout the winter, living on the produce of the summer and autumn; and indeed a cold day in the summer is sufficient to keep them at home, more so than a shower in a warm day: and if the hive is thin, and much exposed, they will hardly move in it, but get as close together as the comb will let them, into a cluster. In this manner they appear to live through the winter: however, in a fine day, they become very lively and active, going abroad, and appearing to enjoy it, at which time they get rid of their excrement; for I fancy they seldom throw out their excrement when in the hive. To prove this, I confined some bees in a small hive, and fed them with honey for some days; and the moment I let them out, they flew, and threw out their excrement in large quantities; and therefore, in the winter, I presume, they retain the contents of their bowels for a considerable time: indeed, when we consider their confinement in the winter, and that they have no place to deposite their excrement, we can hardly account for the whole of this operation in them. Their excrement is of a yellow colour, and according to their confinement it is found higher and higher up in the intestine, almost as high as the crop.

"Their life at this season of the year is more

uniform, and may be termed simple existence, till the warm weather arrives again. As they now subsist on their summer's industry, they would seem to feed in proportion to the coldness of the season; for from experiment, I found the hive grow lighter in a cold week, than it did in a warmer, which led to further experiments. I first made an experiment upon a bee hive, to ascertain the quantity of honey lost through the winter. The hive was put into the scale November the 3d, 1776.

			oz.	drams.
	November 10th	it had lost	2	7
	17th	——	4	2½
	24th	——	3	7½
	December 1st	——	8	2
	8th	——	2	1
	15th	——	5	2
	22d	——	4	3
	29th	——	5	4
1777.	January 1st	——	2	5
	12th	——	5	2
	19th	——	3	4
	26th	——	3	1½
	February 2d	——	5	0
	9th	——	7	0
		The whole	72	1½

"Although an indolent state is very much the condition of bees through the winter, yet progress is making in the queen towards a summer's increase. The eggs in the oviducts are beginning

to swell, and, I believe, in the month of March she is ready to lay them, for the young bees are to swarm in June; which constitutes the queen bee to be the earliest breeder of any insect we know. In consequence of this, the labourers become sooner employed than any other of this tribe of insects. This both queen and labourers are enabled to accomplish, from living in society through the winter; and it becomes necessary in them, as they have their colony to form early in the summer, which is to provide for itself for the winter following. All this requires the process to be carried forward earlier than by any other insect, for these are only to have young which are to take care of themselves through the summer, not being under the necessity of providing for the winter.

"In the month of April, I found in the cells, young bees, in all stages, from the egg to the chrysalis state; some of which were changed in their colour, therefore, were nearly arrived at the fly state, and probably some might have flown.

"As this season is too early for collecting the provision of the maggot abroad, the store of farina comes now into use; but as soon as flowers begin to blow, the bees gather the fresh, although they have farina in store, giving the fresh the preference.

"*Of the Queen.*

"The queen bee, as she is termed, has excited

more curiosity than all the others, although much more belongs to the labourers. From the number of these, and from their exposing themselves, they have their history much better made out: but as there is only one queen, and she scarcely ever seen, it being only the effects of her labour we can come at, an opportunity has been given to the ingenuity of conjecture, and more has been said than can well be proved. She is allowed to be bred in the common way, only that there is a peculiar cell for her in her first stage; and Reaumur says, "her food is different when in the 'maggot state;' but as there is probably but one queen, that the whole might not depend on one life, it is asserted that the labourers have a power of forming a common maggot into a queen. If authors had given us this as an opinion only, we might have passed it over as improbable, but they have endeavoured to prove it by experiments, which require to be examined: and for that purpose, I shall give what they say on that head, with my remarks upon it.

"*Abstracts from Mr.* SCHIRACH.

"The following experiments were made to ascertain the origin of the queen bee:—'In 'twelve wooden boxes were placed twelve pieces 'of comb, four inches square, each containing both eggs and maggots, so suspended 'that the bees could come round every part of

'the comb: in each box was shut up a handful 'of working bees. Knowing that when bees are 'forming a queen, they should be confined*, the 'boxes were kept shut for two days. When ex-'amined at the end of that period (six boxes only 'were opened), in all of them royal cells were 'begun, one, two, or three, in each; all of these 'containing a maggot four days old. In four 'days, the other six boxes were opened, and 'royal cells found in each, containing maggots 'five days old, surrounded by a large provision 'of jelly; and one of these maggots, examined in 'the microscope, in every respect resembled a 'working bee.

"'This experiment was repeated, and the mag-'gots selected to be made queens were three 'days old; and in seventeen days there were 'found in the twelve boxes fifteen lively, hand-'some queens†. These experiments were made 'in May, and the bees were allowed to work 'great part of the summer: the bees were ex-'amined one by one, but no drone could be dis-

* "How he came to know this, I cannot conceive, for nothing *a priori* could give such information."

† "Now this account is not only improbable, but it does not tally with itself. First, it is not probable that a handful of bees should, or would, set about making two, three, or four queens, when we do not find that number in a large hive: and secondly, it seems inconsistent that only fifteen should be formed out of twelve parcels, when some of the former parcels had four young queens."

'covered, and yet the queens were impregnated, 'and laid their eggs*.

"'The above experiment was repeated with 'pieces of comb, containing eggs only, in six 'boxes, but no preparations were made towards 'producing a queen†.

"'The experiment of producing a queen bee 'from a maggot was repeated every month of the 'year, even in November‡.

"'A maggot three days old was procured from 'a friend, inclosed in an ordinary cell, and shut 'up with a piece of comb, containing eggs and 'maggots. That three days old was formed into 'a queen, and all the other maggots and eggs 'were destroyed§.

"'In above a hundred experiments a queen 'has been formed from maggots three days old‖."

* "Here is a wonder of another kind: queens laying eggs, which (we must suppose Mr. Schirach meant we should believe) they hatched, without the influence of the male."

† "Why eggs, which we must conceive hatched, and produced maggots, did not form queens, one cannot imagine."

‡ "In which month, as bees never swarm, there could be no occasion for mothers, or supernumerary queens, and still each experiment produced a handsome queen. This is as singular an observation as any. In this country, and in all similar ones, bees hardly breed after July, and by the beginning of September there is hardly a chrysalis to be seen; yet these bred till November, and even laid eggs."

§ "Why did the bees destroy them in this experiment, and not in others?"

‖ "The working bees, from the above experiments, are considered as all females, although the ovaria are too small for examination.

"It

"Wilhelmi observes, that a queen cell, which is made while the bees are shut up, is formed by breaking down three common cells into one, when the maggot is placed in the centre, after which the sides are repaired.

"A young queen lately hatched was put into a hive, which had been previously ascertained to contain no drones, and whose queen was removed; and yet the young queen laid eggs*. In repeating Mr. Schirach's experiment, he shut up four pieces of comb, with one maggot in each; after two days the maggots were all dead, and the bees had desisted from labour†.

"A piece of comb, from which all the eggs and maggots had been removed, was shut up with some honey, and a certain number of workers; in a short time they became very busy, and upon the evening of the second day 300 eggs were found in the cells‡. He repeated this experiment with the same result, and the bees were left to themselves: they placed queen maggots in the queen cells, newly constructed, and others in male cells: the rest were left undisturbed. He again

"It would appear that a maggot three days old was of the best age for this experiment, yet one should have conceived that a maggot two days old would soon be fit."

* "There is no mystery in this; but did they hatch?"

† "This is the most probable event in the whole experiments."

‡ "This would show that labourers can be changed into queens at will, and that neither they nor their eggs require to be impregnated; if this was the case, there would be no occasion for all the push in making a queen or a male."

took two pieces of comb, which contained neither eggs nor maggots, and shut them up with a certain number of workers, and carried the box into a stove: next evening, one of the pieces of comb contained several eggs, and the beginning of a royal cell, that was empty.

— Besides the short observations contained in the notes, I beg leave to observe, that I have my doubts respecting the whole of these experiments, from several circumstances which occurred in mine. The three following facts appear much against their probability: first, a summer's evening in this country is commonly too cold for so small a parcel of bees to be lively, so as to set about new operations; they get so benumbed, that they hardly recover in the day; and I should suspect that where these experiments were made (and indeed some are said to have been tried in this country), it is also too cold: secondly, if the weather should happen to be so warm as to prevent this effect, then they are so restless, that they commonly destroy themselves, or wear themselves out; at least, after a few days confinement we find them mostly dead: and thirdly, the account given of the formation of a royal cell, without mentioning the above inconvenience, which is natural to the experiment, makes me suspect the whole to be fabricated. To obviate the first objection, which I found from experiment to prevent any success that otherwise might arise, I put my parcel of bees, with their comb, in which were eggs, as also maggots, and

in some of the trials there were chrysalises*, into a warmer place, such as a glass frame, over tan, the surface of which was covered with mould, to prevent the rising of unwholesome air: but from knowing that the maggot was fed with bee-bread, or farina, I took care to introduce a cell or two with this substance, as also the flowers of plants that produce a great deal of it, likewise some honey for the old ones. In this state my bees were preserved from the cold, as also provided with necessaries; but after being confined several days, upon opening the door of the hive, what were alive came to the door, walked and flew about, but gradually left it, and on examining the combs, &c. I found the maggots dead, and nothing like any operation going on.

"The queen, the mother of all, in whatever way produced, is a true female, and different from both the labourers and the male. She is not so large in the trunk as the male, and appears to be rather larger in every part than the labourers. The scales on the under surface of the belly of the labourers are not uniformly of the same colour,

* "I chose to have some chrysalises, for I supposed that if my bees died, or flew away, the chrysalises when they came out, which would happen in a few days, not knowing where to go, might stay and take care of the maggots that might be hatched from the eggs; but, to my surprise, I found that neither the eggs hatched, nor did the chrysalises come forth; all died: from which I began to suspect that the presence of the bees was necessary for both."

over the whole scale; that part being lighter which is overlapped by the terminating scale above, and the uncovered part being darker: this light part does not terminate in a straight line, but in two curves, making a peak; all which gives the belly a lighter colour in the labouring bees; more especially when it is pulled out or elongated.

"The tongue of the female is considerably shorter than that of the labouring bee, more like that of the male: however, the tongues of the labourers are not in all of an equal length, but none have it so short as the queen.

"The size of the belly of the female of such animals varies a little, according to the condition they are in: but the belly of the male and the labourer has but little occasion to change its size, as they are at all times nearly in the same condition with regard to fat, having always plenty of provision: but the true female varies very considerably; she is of a different size and shape in the summer to what she is in the winter; and in the winter she has what may be called her natural size and shape: she is, upon the whole, rather thicker than the labourer; and this thickness is also in the belly, which probably arises from the circumstance of the oviduct being in the winter pretty large, and the reservoir for semen full. The termination of the belly is rather more peaked than in the labourers, the last scale being rather narrower from side to side, and coming more to a point at the anus. The scales at this season are more overlapped, which can only be known by

drawing them out. In the spring and summer she is more easily distinguished: the belly is not only thicker, but considerably longer than formerly, which arises from the increase of the eggs. We distinguish a queen from a working bee, simply by size, and in some degree by colour; but this last is not so easily ascertained, because the difference in the colour is not so remarkable in the back, and the only view we can commonly get of her is on this part; but when a hive is killed, the best way is to collect all the bees, and spread them on white paper, or put them into water, in a broad, flat-bottomed, shallow, white dish, in which they swim; and by looking at them singly, she may be discovered. As the queen breeds the first year she is produced, and the oviducts never entirely subside, an old queen is probably thicker than a new bred one, unless indeed the oviducts, and the eggs, form in the chrysalis state, as in the silk-worm, which I should suppose they did. The queen is perhaps at the smallest size just as she has done breeding, for as she is to lay eggs by the month of March, she must begin early to fill again; but I believe her oviducts are never emptied, having at all times eggs in them, although but small. She has fat in her belly, similar to the other bees.

"It is most probable that the queen which goes off with the swarm is a young one, for the males go off with the swarm to impregnate her, as she must be impregnated the same year, because she breeds the same year.

"The queen has a sting similar to the working bee.

"Of the Number of Queens in a Hive.

"I believe a hive, or swarm, has but one queen, at least I have never found more than one in a swarm, or in an old hive in the winter; and probably this is what constitutes a hive; for when there are two queens, it is likely that a division may begin to take place. Supernumerary queens are mentioned by Riem, who asserts he has seen them killed by the labourers, as well as the males.

"November 18th, 1788, I killed a hive that had not swarmed the summer before, and which was to appearance ready to swarm every day; but when I supposed the season for swarming was over, and it had not swarmed, I began to suspect that the reason why it did not was owing to there being no young queen or queens; and I found only one. This is a kind of presumptive proof that I was right in my conjecture; unless it be supposed, that when they were determined not to swarm, they destroyed every queen except one. In a hive that died, I found no males, and only one queen. This circumstance, that so few queens are bred, must arise from the natural security the queen is in from the mode of their society; for, although there is but one queen in a wasp's, hornet's, and humble bee's nest or hive, yet these breed a great number of queens; the wasp and

hornet some hundreds; but not living in society during the winter, they are subject to great destruction, so that probably not one in a hundred lives to breed in the summer.

"*Of the Male Bee.*

"The male bee is considerably larger than the labourers: he is even larger than the queen, although not so long when she is in her full state with eggs: he is considerably thicker than either, but not longer in the same proportion: he does not terminate at the anus in so sharp a point; and the opening between the two last scales of the back and belly is larger, and more under the belly, than in the female. His proboscis is much shorter than that of the labouring bee, which makes me suspect he does not collect his own honey, but takes that which is brought home by the others; especially as we never find the males abroad on flowers, &c. only flying about the hives in hot weather, as if taking an airing; and when we find that the male of the humble bee, which collects its own food, has as long a proboscis, or tongue, as the female, I think it is from all these facts reasonable to suppose, the male of the common bee feeds at home. He has no sting.

"The males, I believe, are later in being bred than the labouring bee. As they are only produced to go off with a hive, they are not so early brought forth: for in the month of April I killed

a hive, in which I found maggots and chrysalises, but did not find any males among the latter: the maggots are too young for such investigation; but, about the 20th of May we observed males: they are all very much of the same size. In the month of August, probably about the latter end, we may suppose they impregnate the queen for the next year, and about the latter end of the same month, and beginning of September, they are dying, but seem to be hastened to their end by the labourers. In 1791, as early as the 19th of June, I saw the labourers killing the males of a hive, or rather of a swarm, that had not yet swarmed, but was hanging out; this, however, was out of the common course. They appear to be sensible of their fate, for they hurry in and out of the hive as quick as possible, seemingly with a view to avoid the labourers; and we find them attacked by the labourers, who pinch them with their forceps, and when they are so hurt, and fatigued with attempts to make their escape, as not to be able to fly, they are thrown over on the ground, and left to die. That this is the fate of every male bee is easily ascertained, by examining every bee in the hive when killed for the honey, which is after this season; no male being then found in it. Bonnet supposes them starved to death, as he never saw wounds on them. In the course of a winter I have killed several hives, some as late as April, and in such a way as to preserve every bee, and after examining every one entirely, I never perceived one male of any

kind; although it has been asserted there are two sizes of males, and that the small are preserved through the winter to impregnate the queen.

"*Of the Labouring Bee.*

"This class, for we cannot call it either sex, or species, is the largest in number of the whole community: there are thousands of them to one queen, and probably some hundreds to each male, as we shall see by and by. It is to be supposed they are the only bees which construct the whole hive, and that the queen has no other business but to lay the eggs: they are the only bees that bring in materials; the only ones we observe busy abroad; and, indeed, the idea of any other is ridiculous, when we consider the disproportion in numbers, as well as the employment of the others, while the working bee has nothing to take off its attention to the business of the family. They are smaller than either the queen or the males: not all of equal size, although the difference is not very great.

"The queen and the working bees are so much alike, that the latter would seem to be females on a different scale: however, this difference is not so observable in the beginning of winter as in the spring, when the queen is full of eggs. They are all females in construction; indeed, one might suppose that they were only young queens, and that they became queens after a certain age; but

this is not the case. They all have stings, which is another thing that makes them similar to the queen. From their being furnished with an instrument of defence and offence, they are endowed with such powers of mind as to use it, their minds being extremely irritable; so much so, that they make an attack when not meddled with, simply upon suspicion, and when they do attack, they always sting; and yet, from the circumstance of their not being able to disengage the sting, one should suppose they would be more cautious in striking with it. When they attack one another, they seldom use it, only their pincers: yet I saw two bees engaged, and one stung the other in the mouth, or thereabouts, and the sting was drawn from the body to which it belonged, and the one who was stung ran very quickly about with it; but I could not catch that bee, to observe how the sting was situated.

"As they are the collectors of honey, much more than what is for their own use, either immediately, or in future, their tongue is proportionably fitted for that purpose: it is considerably longer than that of either the queen or the male, which fits them to take up the honey from the hollow parts of flowers, of considerable depth. The mechanism is very curious, as will be explained further on.

"The number of labourers in a hive varies very considerably.

"In one hive that I killed, there were - 3338

"In another - - - - - - 4472

"In one that died, there were - - 2432

"That I might guess at the number of bees from a given bulk, I counted what number an alehouse pint held, when wet, and found it contained - - - - 2160

"Therefore, as some swarms will fill two quarts, such must consist of near - - - 9000

"*Of the Parts concerned in the Nourishment of the Bee.*

"Animals who only swallow food for themselves, or whose alimentary organs are fitted wholely for their own nourishment, have them adapted to that use only; but in many, these organs are common for more purposes, as in the pigeon, and likewise in the bee. In this last, some of the parts are used as a temporary reservoir, holding both that which is for the immediate nourishment of the animal, and also that which is to be preserved for a future day, in the cells formerly described; this last portion is therefore thrown up again, or regurgitated. As it is the labourers alone in the common bee that are so employed, we might conceive this reservoir would belong only to them; but both the queen and males, both in the common and humble bee, have it, as also, I believe, every one of the bee tribe.

"As the bee is a remarkable instance of regurgitation, it is necessary the structure of the parts concerned in this operation, and which are also

connected with digestion, should be well considered. Ruminating animals may be reckoned regurgitating animals, but in them it is for the purpose of digestion entirely in themselves. But many birds may be called regurgitating animals, and in them it is for the purpose of feeding their young. Crows fill their fauces, making a kind of craw, out of which they throw back the food when they feed their young: but the most remarkable is the dove tribe, who first fill their craw, and then throw it up into the beak of their young. The bee has this power to a remarkable degree, not, however, for the purpose of feeding the young, but it is the mode of depositing their store, when brought home.

"In none of the above-mentioned regurgitating animals are the reservoirs containing the food, the immediate organ of digestion; nor does the reservoir for the honey in the bee appear to be its stomach.

"The tongue of the bee is the first of the alimentary organs to be considered: it is of a peculiar structure, and is probably the largest tongue of any animal we know, for its size. It may be said to consist of three parts respecting its length, having three articulations. One, its articulation with the head, which is in some measure similar to our larynx. Then comes the body of the tongue, which is composed of two parts; one, a kind of base, on which the other, or true tongue, is articulated. This first part is principally a horny substance, in which there is a groove, and

it is articulated with the first, or larynx; on the end of this is fixed the true tongue, with its different parts. These two parts of the tongue are as it were inclosed laterally, by two horny scales, one on each side, which are concave on that side next to the tongue; one edge is thicker than the other, and they do not extend so far as the other parts. Each of these scales is composed of two parts, or scales, respecting its length, one articulated with the other: the first of those scales is articulated with the common base, or larynx, at the articulation of the first part of the tongue, and incloses laterally the second part of the tongue, coming as far forwards as the third articulation: on the end of this is articulated the second scale, which continues the hollow groove that incloses the tongue laterally; this terminates in a point. These scales have some hairs on their edge.

"On the termination of the second part, is placed the true tongue, having two lateral portions or processes, on each side, one within the other: the external is the largest, and is somewhat similar to the before-mentioned scales. This is composed of four parts, or rather of one large part, on which three smaller are articulated, having motion on themselves. The first, on which the others stand, is articulated at the edges of the tongue, on the basis, or termination of the last described part of the tongue: this has hairs on its edge.

"A little further forwards on the edges of the tongue are two small thin processes, so small as

hardly to be seen with the naked eye. The middle part of all, of which these lateral parts are only appendages, is the true tongue. It is something longer than any of the before-mentioned lateral portions; and is not horny, as the other parts are, but what may be called fleshy, being soft and pliable. It is composed of short sections, which probably are so many short muscles, as in fish; for they are capable of moving it in all directions. The tongue itself is extremely villous, having some very long villi at the point, which act, I conceive, somewhat like capillary tubes.

"This whole apparatus can be folded up, into a very small compass, under the head and neck. The larynx falls back into the neck, which brings the extreme end of the first portion of the tongue within the upper lip, or behind the two teeth; then the whole of the second part, which consists of five parts, is bent down upon and under this first part, and the two last scales are also bent down over the whole; so that the true tongue is inclosed laterally by the two second horny scales, and over the whole lie the two first.

"The œsophagus, in all of this tribe of insects, begins just at the root of the tongue, as in other animals, covered anteriorly by a horny scale, which terminates the head, and which may be called the upper lip, or the roof of the mouth. It passes down through the neck and thorax, and when got into the abdomen, it immediately dilates into a fine transparent bag, which is the immediate receiver of whatever is swallowed. From this the

food (whatever it be) is either carried further on into the stomach, to be digested, or is regurgitated for other purposes. To ascertain this in some degree, in living bees, I caught them going out early in the morning, and found this bag quite empty: some time after I caught others returning home, and found the bag quite full of honey, and some of it had got into the stomach. Now I suppose that which was in the craw, was for the purpose of regurgitation; and as probably they had fasted during the night, part had gone on further for digestion. Whatever time the contents of this reservoir may be retained, we never find them altered, so as to give the idea of digestion having taken place: it is pure honey. From this bag the contents can be moved either way; either downwards to the stomach, for the immediate use of the animal itself; or back again, to be thrown out as store for future aliment.

"The stomach arises from the lower end, and a little on the right side, of this bag. It does not gradually contract into a stomach, nor is the outlet a passage directly out, but in the centre of a projection which enters some way into the reservoir, being rather an inverted pylorus, thickest at its most projecting part, with a very small opening in the centre, of a peculiar construction. This inward projecting part is easily seen through the coats of the reservoir, especially if full of honey.

"The stomach begins immediately on the outside of the reservoir, and the same part which

projects into the reservoir is continued some way into the stomach, but appears to have no particular construction at this end; and therefore it is only fitted to prevent regurgitation into the reservoir, as such would spoil the honey. This construction of parts is well adapted for the purpose; for the end projecting into the reservoir, prevents any honey from getting into the stomach, because its acts there as a valve; therefore whatever is taken in, must be by an action of this vascular part. The stomach has a good deal the appearance of a gut, especially as it seems to come out from a bag. It passes almost directly downwards in the middle of the abdomen. Its inner surface is very much increased, by having either circular valves, somewhat like the *valvulæ conniventes* in the human *jejunum*, or spiral folds, as in the intestine of the shark, &c.; these may be seen through the external coats. In this part the food undergoes the change. Where the stomach terminates, is not exactly to be ascertained; but it soon begins to throw itself into convolutions, and becomes smaller.

"The intestine makes two or three twists upon itself, in which part it is enveloped in the ducts, constituting the liver, and probably the pancreas, and at last passes on straight to the termination of the abdomen. Here it is capable of becoming very large, to serve upon occasion as a reservoir, containing a large quantity of excrement: it then contracts a little, and opens under the posterior edge of the last scale of the back, above the sting

in the female and labourers, and the penis in the male.

"*Of the Senses of Bees.*

"Bees certainly have the five senses. Sight none can doubt. Feeling they also have; and there is every reason for supposing they have likewise taste, smell, and hearing. Taste we cannot doubt: but of smell we may not have such proofs: yet, from observation, I think they give strong signs of smell. When bees are hungry, as a young swarm in wet weather, and are in a glass hive, so that they can be examined, if we put some honey into the bottom, it will immediately breed a commotion; they all seem to be upon the scent: even if they are weak, and hardly able to crawl, they will throw out their probosces as far as possible to get to it, although the light is very faint. This last appears to arise more from smell than seeing. If some bees are let loose in a bee hive, and do not know from which house they came, they will take their stand upon the outside of some hive, or hives; especially when the evening is coming on: whether this arises from the smell of the hives, or sound, I can hardly judge.

"*Of the Voice of Bees.*

"Bees may be said to have a voice. They are certainly capable of forming several sounds. They

give a sound when flying, which they can vary according to circumstances. One accustomed to bees, can immediately tell when a bee makes an attack, by the sound. This is probably made by the wings. They may be seen standing at the door of their hive, with the belly rather raised, and moving their wings, making a noise. But they produce a noise independent of their wings; for if a bee is smeared all over with honey, so as to make the wings stick together, it will be found to make a noise, which is shrill and peevish. To ascertain this further, I held a bee by the legs, with a pair of pincers; and observed it then made the peevish noise, although the wings were perfectly still: I then cut the wings off, and found it made the same noise. I examined it in water, but it then did not produce the noise, till it was very much teased, and then it made the same kind of noise; and I could observe the water, or rather the surface of contact of the water with the air at the mouth of an air-hole at the root of the wing, vibrating. I have observed that they, or some of them, make a noise the evenings before they swarm, which is a kind of ring, or sound of a small trumpet: by comparing it with the notes of the piano forte, it seemed to be the same with the lower A of the treble.

" *Of the Sting of the Bee.*

"I have observed that it is only the queen and the labourers that have stings; and this provision

of a sting is perhaps as curious a circumstance as any attending the bee, and probably is one of the characters of the bee tribe.

"The apparatus itself is of a very curious construction, fitted for inflicting a wound, and at the same time conveying a poison into that wound. The apparatus consists of two piercers, conducted in a groove, or director, which appears to be itself the sting. This groove is somewhat thick at its base, but terminates in a point; it is articulated to the last scale of the upper side of the abdomen by thirteen thin scales, six on each side, and one behind the rectum. These scales inclose, as it were, the rectum or anus all round; they can hardly be said to be articulated to each other, only attached by thin membranes, which allow of a variety of motions; three of them, however, are attached more closely to a round and curved process, which comes from the basis of the groove in which the sting lies, as also to the curved arms of the sting, which spread out externally. The two stings may be said to begin by those two curved processes at their union with the scales, and converging towards the groove at its base, which they enter, then pass along it to its point. They are serrated on their outer edges, near to the point. These two stings can be thrust out beyond the groove, although not far, and they can be drawn within it; and, I believe, can be moved singly. All these parts are moved by muscles, which we may suppose are very strong in them, much stronger than in other animals;

and these muscles give motion in almost all directions, but more particularly outwards. It is wonderful how deep they will pierce solid bodies with the sting. I have examined the length they have pierced the palm of the hand, which is covered with a thick cuticle: it has often been about the $\frac{1}{12}$ of an inch. To perform this by mere force, two things are necessary, power of muscles, and strength of the sting; neither of which they seem to possess in sufficient degree. I own I do not understand this operation. I am apt to conceive there is something in it distinct from simple force applied to one end of a body; for if this was simply the case, the sting of the bee could not be made to pierce by any power applied to its base, as the least pressure bends it in any direction: it is possible the serrated edges may assist, by cutting their way in, like a saw.

"The apparatus for the poison consists of two small ducts, which are the glands that secrete the poison: these two lie in the abdomen, among the air-cells, &c.: they both unite into one, which soon enters into, or forms, an oblong bag, like a bladder of urine; at the opposite end of which passes out a duct, which runs towards the angle where the two stings meet; and entering between the two stings, is continued between them in a groove, which forms a canal by the union of the two stings to this point. There is another duct on the right of that described above, which is not so circumscribed, and contains a thicker matter, which, as far as I have been able to judge, enters

along with the other: but it is the first that contains the poison, which is a thin, clear fluid. To ascertain which was the poison, I dipped points of needles into both, and pricked the back of the hand; and those punctures that had the fluid from the first-described bags in them grew sore and inflamed, while the others did not. From the stings having serrated edges, it is seldom the bees can disengage them; and they immediately upon stinging endeavour to make their escape, but are generally prevented, as it were caught in their own trap; and the force they use commonly drags out the whole of the apparatus for stinging, and also part of the bowels; so that the bee most frequently falls a sacrifice immediately upon having effected its purpose. Upon a superficial view, one conceives, that the first intention of the bee having a sting is evident; one sees it has property to defend, and that therefore it is fitted for defence; but why it should naturally fall a sacrifice in its own defence, does not so readily appear: besides, all bees have stings, although all bees have not property to defend, and therefore are not under the same necessity of being so provided. Probably its having a sting to use, was sufficient for nature to defend the bee, without using it liberally; and the loss of a bee or two, when they did sting, was of no consequence; for it is seldom that more die.

"I have now carried the operations of a hive, or the œconomy of the bee, completely round the year; in which time they revolve to the first point

we set out at, and the continuance is only a repetition of the same revolutions as I have now described: but those revolutions occasion a series of effects in the comb, which effects in time produce variations in the life of the hive. Besides, there are observations that have little to do with the œconomy of a year, but include the whole of the life of this insect, or at least its hive.

"*Of the Life of the Bee.*

"I have observed that the life of the male is only one summer, or rather a month or two; and this we know from there being none in the winter, otherwise their age could not be ascertained, as it is impossible to learn the age of either the queen or labourers. Some suppose that it is the young bees which swarm; and most probably it is so: but I think it is probable also, that a certain number of young ones may be retained to keep up the stock, as we must suppose that many of the old ones are, from accidents of various kinds, lost to the hive; and we could conceive, that a hive three or four years old might not have an original bee in it, although a bee might live twice that time. But there must be a period for a bee to live; and if I were to judge from analogy, I should say, that a bee's natural life is limited to a certain number of seasons; viz. one bee does not live one year, another two, another three, &c. I even conceive that no individual insect of any species

lives one month longer than the others of the same species. I believe this is the case with all insects; but the age of either a labourer or a queen may never be discovered. One might suppose that the life of a bee, and the time a hive can possibly last, would be nearly equal: although this is not absolutely necessary, because they can produce a succession, which they probably do; for I am very ready to imagine, that after the first brood in the season, all the last winter bees die, and the hive is occupied with this first brood; and that they breed the first swarm, or that the old breed the whole of this season's breeding, and then die, and those that continue through the winter are the young; and if so, then they follow the same course with their progenitors.

"The comb of a hive may be said to be the furniture and storehouse of the bees, which by use wear out; and from the description I have given, it will appear that the comb in time will be rendered unfit for use. I observed, that they did not clean out the excrement of the maggot, and that the maggot, before it moved into the chrysalis state, lined the cell with a silk, similar to many other insects. It lines the whole cell, top, sides, and bottom; the two last are permanent; and at the bottom it covers with this lining its own excrement*. Why the bee maggot is formed to do this, is, probably, because honey afterwards is to

* "This neither the wasp nor hornet do, although they do not clean out the excrement of their maggots."

be put into this cell; so that the honey is laid into this last silken bag. How often they may breed in the same cell I do not know, but I have known them three times in the same season; each time the excrement has been accumulating, and the cell has been lined three times with silk. From this account we must see that a cell, in time, will be so far filled up as to render it unfit for breeding. On separating the lining of silk, which is easiest done at the bottom, on account of the dried excrement between each lining, I have counted above twenty different linings in one cell, and found the cell about one quarter, or one third, filled up: when such a cell, or a piece of comb with such cells, is steeped in water, so as to soften the excrement between the linings, they are separated from each other at the bottom by the swelling of the excrement, so that they can be easily counted. A piece of comb so circumstanced, when boiled for the wax, will keep its form, and the small quantity of wax is squeezed out at different parts, as if squeezed out of a sponge, and runs together into the crevices: while a piece of comb, that never has been bred in, even of the same hive, melts almost wholly down. It is this wax that has the fine yellow, while the other of the same hives, although brown, yet shall be white when melted; so that I was led to imagine the wax took its tinge from the farina, excrement, &c. but upon boiling pure wax with such materials, it was not tinged with this transparent yellow, only became dirty. In some of those cells that had

probably been bred in twenty times, or more, when soaked so as to make the excrement swell, I have seen the bottom of the last lining rise even with the mouth, or top of the cell, so that the cavity of the cell was now full: in others, I have seen it rise higher than the mouth, so that the last formed layers were almost inverted, and turned inside out. A piece of such comb, consisting of two rows of cells, is to be considered as a mould, and the lining of silk and the excrement as the cast; when this is boiled, so as either to extract all the wax or mould, or to destroy its original regular formation which constituted the comb, and nothing is left but the cells of silk, &c. they all easily separate from each other, being only so many casts, with the mould destroyed; and the bottoms, which were indented into each other, are very perfect.

"From the above account we must see that the combs of a hive can only last a certain number of years; however, to make them last longer, the bees often add a little to the mouth of the cell, which is seldom done with wax alone, but with a mixture; and they sometimes cover the silk lining of the last chrysalis; but all this makes such cells clumsy, in comparison to the original ones."

The *Apis centuncularis* or *Carpenter-Bee* is remarkable for its faculty of forming long, tubular, and slightly flexuose cavities in wood, even of the most solid kind, as oak, &c. Sometimes it performs this operation in living trees, and sometimes in dry wood, posts, &c. The tubular cavi-

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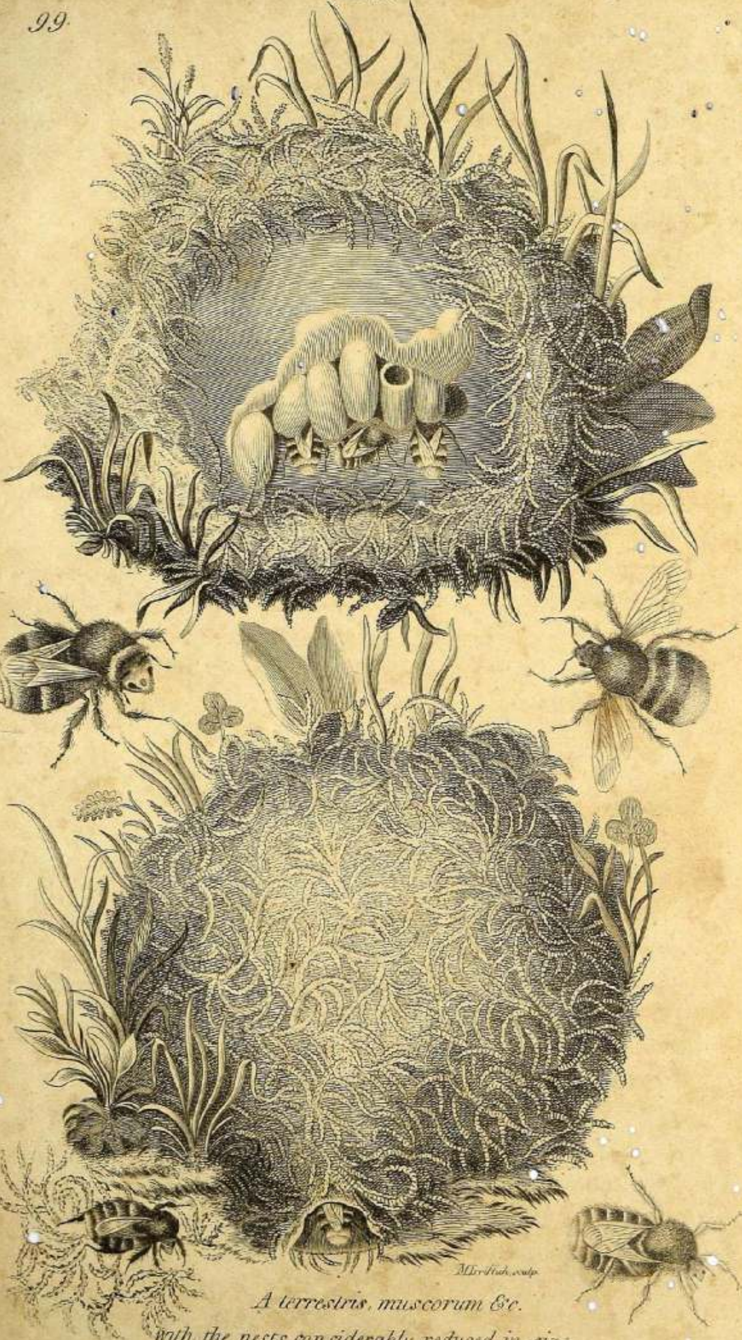


M.Griffith, sculp.

A terrestris, muscorum &c.
with the nests considerably reduced in size

1805, Oct. 1 London, Published by G. Kearsley, Fleet Street.

ties extend several inches in length and are about the third of an inch in diameter, and is marked into separate spaces, each of the length of three quarters of an inch. When the tube is properly finished the animal proceeds to line each of the above-mentioned spaces with rose-leaves rolled over each other, the bottom of each being formed by several circular pieces of these leaves placed immediately over each other to a sufficient thickness. The animal then deposits an egg at the bottom, and having left in the cell a sufficient quantity of a kind of honey for the nourishment of the young larva when hatched, proceeds to close the top with circular bits of rose-leaf; and thus proceeding, finishes the whole series. This is usually done towards the close of summer, and the young having passed the period of their larva state, change into that of chrysalis, and remain the whole winter, not making their appearance till pretty late in the ensuing season. This bee is about the size of the common or honey-bee, but shorter and broader-bodied in proportion, and is of a dusky colour above, the lower parts being covered with a bright-ferruginous down or hair*. In seasons when this species happens to be plentiful it does considerable injury to the trees which it attacks; large trunks of apparently healthy oaks having been found very materially injured by the numerous trains of cells distributed through it in different

* Mr. Kirby, in his Monographia, considers this species as distinct from the real *centuncularis*, and names it *Apis ligniscea*.

parts, thirty, forty, or fifty tubes sometimes lying within a very small distance of each other. In defect of rose-leaves the cavities are sometimes lined with the leaves of elm, &c. &c.

A species very nearly allied to the preceding pursues a similar plan of forming a continued series of cylindrical nests with rose or other leaves, rolling them in such a manner as to resemble so many thimbles, the top of each being closed as before. Instead however of being placed in the timber of trees, they are laid in horizontal trains at a certain distance beneath the surface of the ground. Monsr. Reaumur, who describes this species and its nest, relates a very diverting instance of popular ignorance and superstition at that period in France. In the beginning of July 1736, the learned Abbé Nollet, then at Paris, was surprised by a visit from an Auditor of the Chamber of Accounts, whose estate lay at a distant village on the borders of the Seine, a few leagues from Rouen. This gentleman came accompanied, among other domestics, by a gardener, whose face had an air of much concern. He had come to Paris in consequence of having found in his master's grounds many rows of leaves, unaccountably disposed in a mystical manner, and which he could not but believe were there placed by witchcraft, for the secret destruction of his lord and family. He had, after recovering from his first consternation, shewn them to the Curé of the parish, who was inclined to be of a similar opinion, and advised him without delay to take a journey to

Paris, and make his lord acquainted with the circumstance. This gentleman, though not quite so much alarmed as the honest gardener, yet could not feel himself at perfect ease; and therefore thought it advisable to consult his surgeon upon the business, who, though a man of eminence in his profession, declared himself utterly unacquainted with the nature of what was shewn him, but took the liberty of advising that the Abbé Nollet, as a philosopher, should be consulted, whose well-known researches in natural knowledge might perhaps enable him to elucidate the matter. It was in consequence of this advice that the Abbé received the visit above-mentioned, and had the satisfaction of relieving all parties from their embarrassment, by shewing them several nests formed on a somewhat similar plan by other insects, and assuring them that those in their possession were the work of Insects also. He opened some of the rose-leaf nests, shewed them the inclosed larvæ, and requested permission to send the remainder to Monsr. Reaumur, who pursued their investigation with much eagerness, and soon completed the natural history of the animal.

Of the villose or hairy Bees, popularly called Humble-Bees, one of the largest and most common is the *Apis lapidaria* of Linnæus, so named from the circumstance of its nest being generally situated in strong or gravelly places. This species is entirely of a deep black colour, except the end of the abdomen, which is red or orange-coloured, more or less deep in different individuals. The

female is of large size, measuring near an inch in length; the male is considerably smaller, and the neuter or labouring bee still smaller than the male.

The *Apis terrestris* is of equal size with the former, and is of a black colour, with the thorax marked by a yellow bar, and the abdomen tipped with white.

The *Apis hortorum* resembles the preceding, but has the thorax and abdômen yellow in front, and the body tipped with white like the former.

The Humble-Bees in general live in small societies of forty or sixty together, in an oval or roundish nest, excavated to a small depth beneath the surface of the ground, and formed of branches of moss, compacted together, and lined with a kind of coarse wax. In this nest, which measures from four to six inches in diameter, are constructed several oval cells, which however are not the work of the complete insects, but are the cases spun by the larvæ, and in which they remain during their state of chrysalis: the eggs are deposited among heaps of a kind of coarse honey or bee-bread, placed here and there at uncertain intervals; on this substance the larvæ feed during their growing state: lastly, in every nest are placed a few nearly cylindric cells or goblets of coarse wax, and filled with pure honey, on which feed the complete insects.

Reaumur observes that Humble-Bees are sometimes infested with numerous small worms of the tribe of Ascarides. These are found in the middle

of their bodies, and are enclosed in a kind of cyst or capsule. It may be added that many insects are infested with still more extraordinary inmates, viz. Gordii or Filariæ of several inches in length.

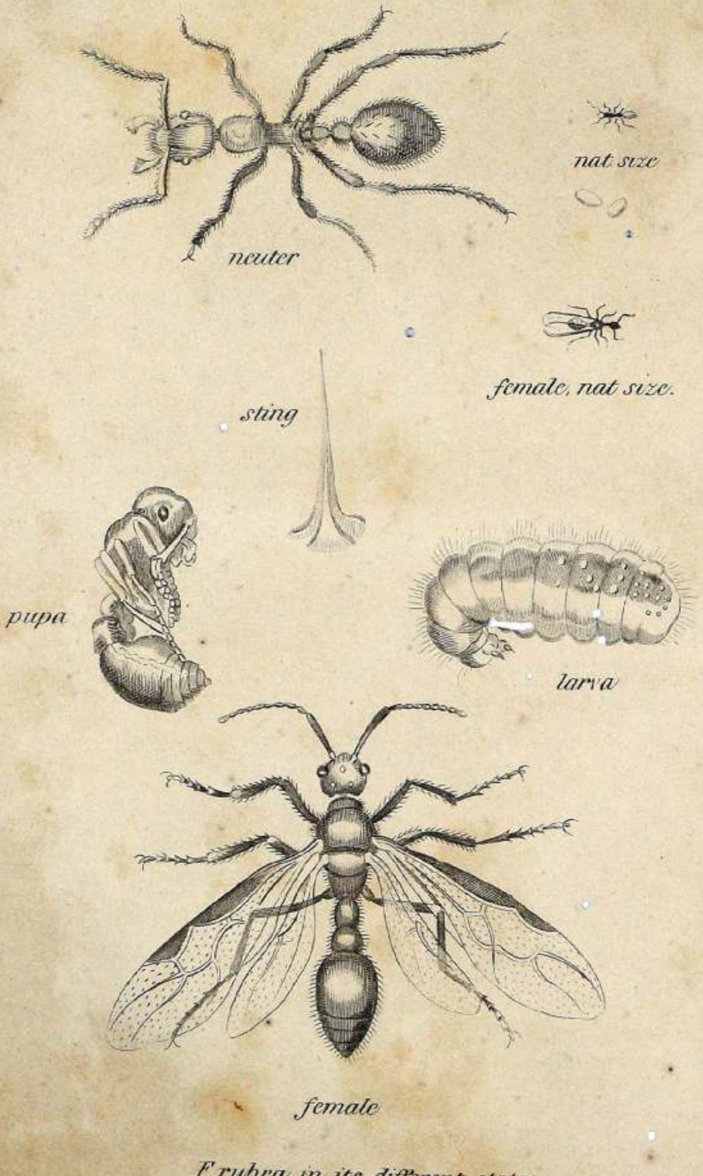
It would be unpardonable to dismiss the genus Apis without calling the attention of the reader to the ingenious Mr. Kirby's elaborate publication entitled *Monographia Apum Angliæ*, a work in which the British species of this extensive genus are defined with an accuracy surpassing the usual tenor of entomological description.

FORMICA. ANT.

Generic Character.

Caput magnum, antennis diffractis, filiformibus.	*Head* large, with diffracted filiform antennæ.
Os maxillosum, palpis quatuor inæqualibus.	*Mouth* with large jaws, and four unequal feelers.
Thorax postice angustatus, squamula erecta.	*Thorax* narrowed behind, and furnished with an upright scale.
Abdomen subglobosum.	*Abdomen* subglobose.
Alæ maribus et feminis: neutris nullæ.	*Males* and *Females* winged: *Neutrals* apterous.
Aculeus feminis et neutris, reconditus.	*Females* and *Neutrals* furnished with a concealed sting.

THE insects of this genus live in large societies, somewhat in the manner of Bees and Wasps, and are like them divided into males, females, and neutrals, which latter constitute the great or general assortment, and appear to conduct the business of the nest, which is usually placed at a small distance from the surface in some slight elevation either prepared by the insects themselves or previously formed by some other animals, as Moles, &c. They feed both on animal and vegetable sub-



F. rubra in its different states

Heath sculp

1805. Oct. 1. London Published by G. Kearsley Fleet Street.

stances, devouring the smaller kind of insects, caterpillars, &c. as well as fruits of different kinds. They are particularly attracted by sweets, and for this reason they ascend such trees as are infested with Aphides, in order to obtain the saccharine substance discharged by those animals; and hence seems to have arisen the idea of their enmity against the genus Aphis. Some species of Ants are furnished with a sting, while others are destitute of that part.

The largest of the European Ants is the *Formica Herculanea*, or Great Wood-Ant, of a chesnut colour, with the abdomen measuring two lines or more in length. This species is chiefly found in dry woods of pine or fir, where it inhabits a large conical nest or hilloc, composed of dry vegetable fragments, chiefly of fir-leaves: the nest is internally distributed into several paths or tubes, converging towards the central part, and opening externally: in the middle or centre reside the young, or larvæ, which are nursed by the neutral ants, and are occasionally brought to the surface, in order to be more within the influence of the air and sunshine for a certain time, after which they are again conveyed to the bottom or centre. When full grown, they envelop themselves in oval, white, silken cases, in which they undergo their change into chrysalis, and at length emerge in their complete form. The males and females are winged, and the females are much larger than the males.

The common or black Ant, *Formica nigra. Lin.*

is a well-known inhabitant of our fields and gardens, residing in great numbers beneath mole-hills and other elevated spots. It is of a brownish black colour, and of a glossy or polished surface. The eggs of this species are deposited early in the spring, and are extremely small, and of a white colour. From these are hatched the larvæ, which are of a thickish form, destitute of legs, and somewhat resemble in miniature the maggots of Wasps and Bees. They are carefully nourished by the neutral or labouring ants, till they are arrived at their full growth, when they enclose themselves in smooth, oval, pale yellow, silken webs or cases, in which state they are popularly known by the mistaken title of ant-eggs; the real eggs, as before observed, being white, and extremely small. It is generally in the months of June and July that the larvæ thus enclose themselves. The chrysalis, if taken out of its silken case, is of a white colour, and exhibits all the limbs of the future animal in an imperfect or contracted state. During the time of their remaining in chrysalis the neutral ants attend them with the same care as when in their larva state, frequently shifting their situation *, and placing them at greater or smaller elevations according to the different state of the atmosphere.

About the beginning of August the males and females may be observed in the nests: these differ

* This care of the Ants in conveying their pupæ from place to place seems to have been often mistaken for a sedulous industry in collecting grains of wheat, which the pupæ, on a cursory view, much resemble.

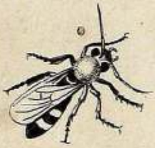
from the neutrals in being furnished with wings, and the female is far larger than the male, the body equalling in size that of the common window-fly, and the upper wings being very long and large. At this time of the year the males and females emigrate in vast numbers, sometimes flying at a considerable height, and sometimes creeping along the surface. It is not uncommon to see them enter houses at this period, attracted by sweets in particular, either moist or dry. After the breeding season the males live but a very short time, and the females return to their nests in order to deposit their eggs. During the winter this species, like the rest of the European ants, remains in a state of torpor, without laying up provisions for that season, as erroneously supposed; and during the spring emerges from its concealment, and recommences its labours.

I have before observed that Ants feed both on animal and vegetable substances of various kinds. Their addiction to animal substances is often turned to good account by anatomists, who, when they wish to obtain the skeleton of any animal too small or delicate to admit of being prepared in the usual way, dispose the animal in a proper position in a small box, with perforations in the lid, and deposit it in a large ant-hill; in consequence of which, after a certain space, the whole of the softer parts are eaten away by these insects, and the skeleton remains in its proper position. It is thus that very elegant skeletons of Frogs, Snakes, &c. may be obtained.

This addiction to animal food in the insects of the genus Formica can hardly be said to be productive of any mischief in the European regions; but in various parts of America and the West-Indian islands the ravages committed by ants are incredible. One of the chief of these destroyers is the *Formica omnivora* of Linnæus, a very small species of a brown or chesnut colour: it is extremely voracious, attacking every animal substance to which it can gain access. It occurs in various parts of Africa as well as in America and the West Indies, and it is said to be so numerous in some districts, that a deer, hog, &c. being killed and left on the ground by night, will by the next morning have the flesh entirely cleared from the bones, and be reduced to a complete skeleton.

MUTILLA.

head magnified



Europæa

Americana

Heath sculp

1805, Oct.r 1 London, Published by G Kearsley, Fleet Street

MUTILLA. MUTILLA.

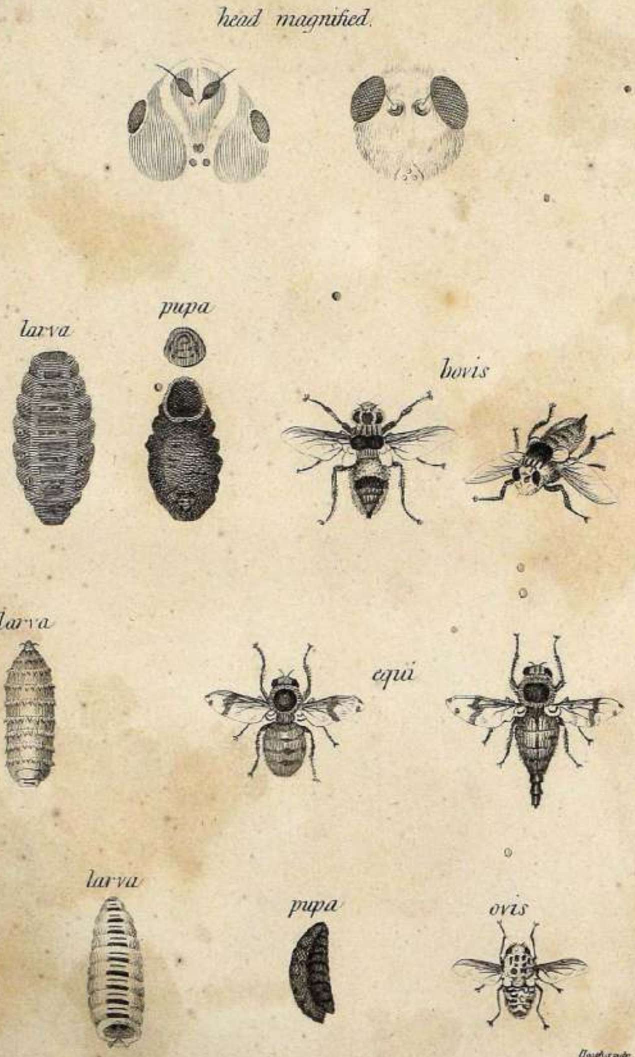
Generic Character.

Antennæ filiformes.	*Antennæ* filiform.
Corpus pubescens: *thorax* postice retusus.	*Body* downy: *thorax* retuse behind.
Alæ nullæ plerisque.	*Wings* none in general.
Aculeus punctorius, reconditus.	*Sting* concealed.

IN many particulars the insects of this genus resemble those of the immediately preceding, but are of larger size, and more lively colours. The principal European species, the *Mutilla Europæa* of Linnæus, is a beautiful animal, of a deep black colour, of a silky or velvety surface, with the thorax rufous in front, and sometimes entirely so, and the abdomen marked by two white bands, a yellowish cast or gloss often appearing on the whole. It is found in woods and fields, beneath moss, &c. measures about half an inch in length. It appears to live in small societies in the manner of ants, some individuals being winged, and others apterous.

Mutilla occidentalis of Linnæus is of a bright red colour, with a velvety surface, and is marked by a black band across the abdomen. It is a native of many parts of North America.

Mutilla Americana is an elegant species, of a black colour, with the abdomen marked on the first segment by four red spots, and on each of the rest by three large white ones, giving the appearance of three longitudinal white stripes on that part. It is a native of South America.



1805 Octr 1st London Published by G. Kearsley Fleet Street.

INSECTS.

ORDER

DIPTERA.

OESTRUS. OESTRUS.

Generic Character.

Antennæ triarticulatæ, brevissimæ, demersæ.	*Antennæ* triarticulate, very short, sunk.
Facies lata, depressa, vesiculosa.	*Face* broad, depressed, vesicular.
Os foramen simplex.	*Mouth* a simple orifice.
Palpi duo, biarticulati, demersi.	*Feelers* two, biarticulate, sunk.
Cauda inflexa.	*Tail* inflected.

THE genus Oestrus or Gad-Fly is remarkable, like that of Ichneumon, for the singular residence of its larvæ; viz. beneath the skin, or in different parts of the bodies of quadrupeds.

The principal European species is the *Oestrus Bovis* or Ox Gad-Fly. This is about the size of a common Bee, and is of a pale yellowish brown colour, with the thorax marked by four longitudinal dusky streaks, and the abdomen by a black bar across the middle, the tip being covered with tawny or orange-coloured hairs: the wings are pale brown, and unspotted.

The female of this species, when ready to deposit her eggs, fastens on the back of a heifer or cow, and piercing the skin with the tube situated at the tip of the abdomen, deposits an egg in the puncture: she then proceeds to another spot at some distance from the former, repeating the same operation at intervals on many parts of the animal's back. This operation is not performed without severe pain to the animal on which it is practised; and it is for this reason that cattle are observed to be seized with such violent horror when apprehensive of the approaches of the female Oestrus; flying with uncontrollable rapidity, and endeavouring to escape their tormentor by taking refuge in the nearest pond; it being observed that this insect rarely attacks cattle when standing in water.

In the punctures of the skin thus formed by the Gad-fly the several eggs hatch, and the larvæ by their motion and suction cause so many small swellings or abscesses beneath the skin, which growing gradually larger, become externally visible, exhibiting so many tubercles an inch or more

in diameter, with an opening at the top of each, through which may be observed the larva, imbedded in a purulent fluid: its appearance is that of an oval maggot, of a yellowish white colour while young, but growing gradually darker as it advances in age, till at the time of its full growth it is entirely brown. It is chiefly in the months of August and September that the eggs are laid, and the larvæ remain through the ensuing winter and till the latter part of the next June before they are ready to undergo their change into chrysalis. At this period they force themselves out from their respective cells, and falling to the ground, each creeps beneath the first convenient shelter, and lying in an inert state becomes contracted into an oval form, but without casting the larva skin, which dries and hardens round it. When the included insect is ready for exclusion, it forces open the top of the pupa or chrysalis coat, and emerges in its perfect form, having remained within the chrysalis somewhat more than a month.

Though the history of this insect in its larva state has long ago been detailed with sufficient accuracy by Vallisneri, Reaumur and others, yet the Fly itself appears to have been very generally confounded, and that even by Linnæus himself, with a very different species, resembling it in size, but which is bred in the stomach and intestines of horses, the larvæ being no other than the whitish, rough maggots which Farriers call by the title of Bots. This insect is the *Oestrus Equi*, ex-

tremely well described by Mr. Bracy Clark in the third volume of the Transactions of the Linnæan Society. It is a trifle smaller than the *Oestrus bovis*, and is of a yellowish brown colour, with a dusky band across the thorax, and the tip of the abdomen of similar colour: the wings are whitish, with a pale-dusky bar across the middle of each, and two dusky spots at the tip.

The manner in which the young larvæ or Bots are introduced into the stomach and bowels of the animal they infest is singularly curious, and cannot be better delivered than in the words of the ingenious observer.

"When the female has been impregnated, and the eggs are sufficiently matured, she seeks among the horses a subject for her purpose, and approaching it on the wing, she holds her body nearly upright in the air, and her tail, which is lengthened for the purpose, curved inwards and upwards: in this way she approaches the part where she designs to deposit her egg; and suspending herself for a few seconds before it, suddenly darts upon it, and leaves her egg adhering to the hair: she hardly appears to settle, but merely touches the hair with the egg held out on the projected point of the abdomen. The egg is made to adhere by means of a glutinous liquor secreted with it. She then leaves the horse at a small distance, and prepares a second egg, and, poising herself before the part, deposits it in the same way. The liquor dries, and the egg becomes firmly glued to the hair: this is repeated by various flies till four or five hundred

eggs* are sometimes placed on one horse. The horses, when they become used to this fly, and find that it does them no injury, as the *Tabani* and *Conopes*, by sucking their blood, hardly regard it, and do not appear at all aware of its insidious object. The skin of the horse is always thrown into a tremulous motion on the touch of this insect, which merely arises from the very great irritability of the skin and cutaneous muscles at this season of the year†, occasioned by the continual teasing of the flies, till at length these muscles act involuntarily on the slighest touch of any body whatever. The inside of the knee is the part on which these flies are most fond of depositing their eggs, and next to this on the side and back part of the shoulder, and less frequently on the extreme ends of the mane. But it is a fact worthy of attention, that the fly does not place them promiscuously about the body, but constantly on those parts which are most liable to be licked with the tongue; and the ova therefore are always scrupulously placed within its reach. The eggs thus deposited I at first supposed were loosened from the hairs by the moisture of the tongue, aided by its roughness, and were conveyed to the stomach, where they were hatched; but on more minute search I do not find this to be the case, or at least only by accident; for when they have remained on the hairs four or five days they become ripe, after which time the slightest application of warmth and

* Horses sometimes appear to be nearly covered by them.

† August and September.

moisture is sufficient to bring forth in an instant the latent larva. At this time, if the tongue of the horse touches the egg, its operculum is thrown open, and a small active worm is produced, which readily adheres to the moist surface of the tongue, and is from thence conveyed with the food to the stomach. If the egg itself be taken up by accident, it may pass on to the intestinal canal before it hatches; in which case its existence to the full growth is more precarious, and certainly not so agreeable, as it is exposed to the bitterness of the bile. I have often with a pair of scissars clipped off some hairs with eggs on them from the horse, and on placing them in the hand, moistened with saliva, they have hatched in a few seconds. At other times, when not perfectly ripe, the larva would not appear, though held in the hand under the same circumstances for several hours; a sufficient proof that the eggs themselves are not conveyed to the stomach. It is fortunate for the animals infested by these insects that their numbers are limited by the hazards they are exposed to. I should suspect near a hundred are lost for one that arrives at the perfect state of a fly. The eggs, in the first place, when ripe, often hatch of themselves, and the larva, without a nidus, crawls about till it dies; others are washed off by the water, or are hatched by the sun and moisture, thus applied together. When in the mouth of the animal, they have the dreadful ordeal of the teeth and mastication to pass through. On their arrival at the stomach, they may pass, mixed with the

mass of the food, into the intestines; and when full grown, on dropping from the anus to the ground, a dirty road or water may receive them. If on the commons, they are in danger of being crushed to death, or of being picked up by the birds who so constantly for food attend the footsteps of the cattle. Such are the contingencies by which Nature has wisely prevented the too great increase of their numbers, and the total destruction of the animals they feed on. I have once seen the larva of this Oestrus in the stomach of an Ass; indeed there is little reason to doubt their existence in the stomachs of all this tribe of animals."

"These larvæ attach themselves to every part of the stomach, but are generally most numerous about the pylorus, and are sometimes, though much less frequently, found in the intestines. Their numbers in the stomach are very various, often not more than half a dozen, at other times more than a hundred, and if some accounts might be relied on, even a much greater number than this. They hang most commonly in clusters, being fixed by the small end to the inner membrane of the stomach, which they adhere to by means of two small hooks or tentacula. When they are removed from the stomach they will attach themselves to any loose membrane, and even to the skin of the hand."

"The body of the larva is composed of eleven segments, all of which, except the two last, are surrounded with a double row of horny bristles directed towards the truncated end, and are of a

reddish colour, except the points, which are black. These larvæ evidently receive their food at the small end, by a longitudinal aperture, which is situated between two hooks or tentacula. Their food is probably the chyle, which, being nearly pure aliment, may go wholly to the composition of their bodies without any excrementitious residue, though on dissection the intestine is found to contain a yellow or greenish matter, which is derived from the colour of the food, and shews that the chyle, as they receive it, is not perfectly pure."

"They attain their full growth about the latter end of May, and are coming from the horse from this time to the latter end of June, or sometimes later. On dropping to the ground they find out some convenient retreat, and change to the chrysalis; and in about six or seven weeks the fly appears."

To the above account by Mr. Clark I have only to add that the most successful method of obtaining the flies from the chrysalis is by taking the larvæ, when fresh dropped from the horse, and immediately enclosing them separately in balls of fresh horse-dung, which must be kept in a warm situation, and sprinkled every second or third day with water: the animals will thus be preserved in a proper degree of warmth and moisture, and the flies will make their appearance in the usual time.

Oestrus Ovis, or the Sheep Gad-Fly, is so named from its larva inhabiting the nostrils and frontal sinuses of Sheep in particular, though it is also

found in similar situations in Deer and some other quadrupeds. It is a smaller species than either of the two preceding, and is of a whitish-grey colour, with the thorax marked by four longitudinal black streaks, and the abdomen speckled with black. The larvæ are nearly as large as those of the *Oestrus Equi*, and, according to the observations of Mr. Clark, are of a delicate white colour, flat on the under side, and convex on the upper; having no spines at the divisions of the segments, though they are provided with tentacula at the small end. The other is truncated, with a prominent ring or margin. When young these larvæ are perfectly white and transparent, but as they increase in size the upper side becomes marked with two transverse brown lines on each segment, and some spots are seen on the sides. They move with considerable quickness; holding with their tentacula as a fixed point, and drawing up the body towards them. Mr. Clark in his description of this species observes that he has mostly found the larvæ in the horns and frontal sinuses of Sheep, and remarks that the membranes lining these cavities were hardly at all inflamed, while those of the maxillary sinuses were highly so. From this circumstance he is led to suspect that they inhabit the maxillary sinuses, and crawl, on the death of the animal, into these situations in the horns and frontal sinuses. When full-grown they fall through the nostrils, and change to the pupa or chrysalis state, lying on the ground, or adhering to some blade of grass. The fly pro-

ceeds from the chrysalis in the space of about two months.

"The manner, (says Mr. Clark,) in which this species deposits its ova has, I believe, not been described; nor is it easy to see, though close to the animal at the time, exactly in what way this is accomplished, owing to the extreme agitation of the Sheep; but the motions of the Sheep afterwards, and the mode of defence it takes to avoid it, can leave but little doubt that the egg is deposited on the inner margin of the nostril. The moment the fly touches this part of the Sheep, they shake their heads, and strike the ground violently with their fore-feet; at the same time, holding their noses close to the earth, they run away, looking about them on every side, to see if the fly pursues: they also smell to the grass as they go, lest one should be lying in wait for them. If they observe one, they gallop back, or take some other direction. As they cannot, like the horses, take refuge in the water, they have recourse to a rut, or dry dusty road, or gravel pits, where they crowd together during the heat of the day, with their noses held close to the ground, which renders it difficult for the fly conveniently to get at the nostril. Observations on these flies are best made in warm weather, and during the heat of the day, when, by driving the sheep from their retreats to the grass, the attack of the fly and the emotions of the sheep are easily observed."

The other British Oestri are the *O. hæmorrhoidalis* of Linnæus, whose larva, like that of the

O. Equi, resides in the stomachs of horses, and the *O. veterinus* of Mr. Clark, the larva of which is also found in similar situations. The *O. hæmorrhoidalis* is about the size of a common window-fly, with pale dusky wings, brown thorax, abdomen white at the base, black in the middle, and red at the tip. The *O. veterinus* is nearly of similar size with the *O. Equi*, and is entirely of a ferruginous colour, with the abdomen more dusky towards the tip.

The exotic Oestri are probably numerous, but are at present very little known.

Whether the formidable African Fly, described by Mr. Bruce under the name of *Zimb** or *Tsaltsalya* may be referred to this genus or not, I shall not pretend to determine: there are however some particulars in its history which would lead one to suppose it an Oestrus.

"This insect (says Mr. Bruce,) is a proof how fallacious it is to judge by appearances. If we consider its small size, its weakness, want of variety or beauty, nothing in the creation is more contemptible and insignificant. Yet passing from these to his history, and to the account of his powers, we must confess the very great injustice we do him from want of consideration. We are obliged, with the greatest surprise, to acknowledge, that those huge animals the Elephant, the Rhinoceros, the Lion, and the Tiger, inhabiting the same woods, are still vastly his inferiors, and

* Bruce's travels, vol. I. p. 388, and vol. V. p. 188.

that the appearance of this small insect, nay, his very sound, though he is not seen, occasions more trepidation, movement, and disorder, both in the human and brute creation, than would whole herds of these monstrous animals collected together, though their number was in a tenfold proportion greater than it really is."

"This insect is called *Zimb;* it has not been described by any naturalist. It is in size very little larger than a Bee, and his wings, which are broader than those of a bee, placed separate, like those of a Fly: they are of pure gauze, without colour or spot upon them; the head is large, the upper jaw or lip is sharp, and has at the end of it a strong-pointed hair of about a quarter of an inch long; the lower jaw has two of these pointed hairs, and this pencil of hairs, when joined together, makes a resistance to the finger nearly equal to that of a strong hog's bristle. Its legs are serrated in the inside, and the whole covered with brown hair or down. As soon as this plague appears, and their buzzing is heard, all the cattle forsake their food, and run wildly about the plain, till they die, worn out with fatigue, fright, and hunger. No remedy remains for the residents on such spots but to leave the black earth, and hasten down to the sands of Atbara, and there they remain while the rains last, this cruel enemy never daring to pursue them farther."

"What enables the shepherd to perform the long and toilsome journies across Africa is the Camel, emphatically called the *ship of the desert.*

Though his size is immense, as is his strength, and his body covered with a thick skin, defended with strong hair, yet still he is not capable to sustain the violent punctures the fly makes with his proboscis. He must lose no time in removing to the sands of Atbara; for when once attacked by this fly, his body, head, and legs, break out into large bosses, which swell, break, and putrify, to the certain destruction of the creature. Even the Elephant and Rhinoceros, who, by reason of their enormous bulk, and the vast quantity of food and water they daily need, cannot shift to desert and dry places as the season may require, are obliged to roll themselves in mud and mire, which, when dry, coats them over like armour, and enables them to stand their ground against this winged assassin; yet I have found some of these tubercles upon almost every Elephant and Rhinoceros that I have seen, and attribute them to this cause."

"All the inhabitants of the sea-coast of Melinda, down to Cape Gardefan, to Saba, and the south of the Red Sea, are obliged to put themselves in motion and remove to the next sand in the beginning of the rainy season, to prevent all their stock of cattle from being destroyed. This is not a partial emigration; the inhabitants of all the countries from the mountains of Abyssinia northward, to the confluence of the Nile and Astaboras, are once a-year obliged to change their abode, and seek protection in the sands of Beja; nor is there any alternative, or means of avoiding this,

though a hostile band was in their way, capable of spoiling them of half their substance."

"Of all that have written upon these countries, the prophet Isaiah alone has given an account of this animal, and the manner of its operation. "*And it shall come to pass in that day, that the Lord shall hiss for the fly that is in the uttermost part of the rivers of Egypt.*"—"*And they shall come, and shall rest all of them in the desolate vallies, and in the holes of the rocks, and upon all thorns, and upon all bushes.*" *Isai. ch.* 17. *v.* 18. 19.

By the expression of resting in the desolate vallies &c. Mr. Bruce understands the Prophet to mean "that they shall cut off from the cattle their usual retreat to the desert, by taking possession of those places, and meeting them where ordinarily they never come, and which therefore are the refuge of the cattle."

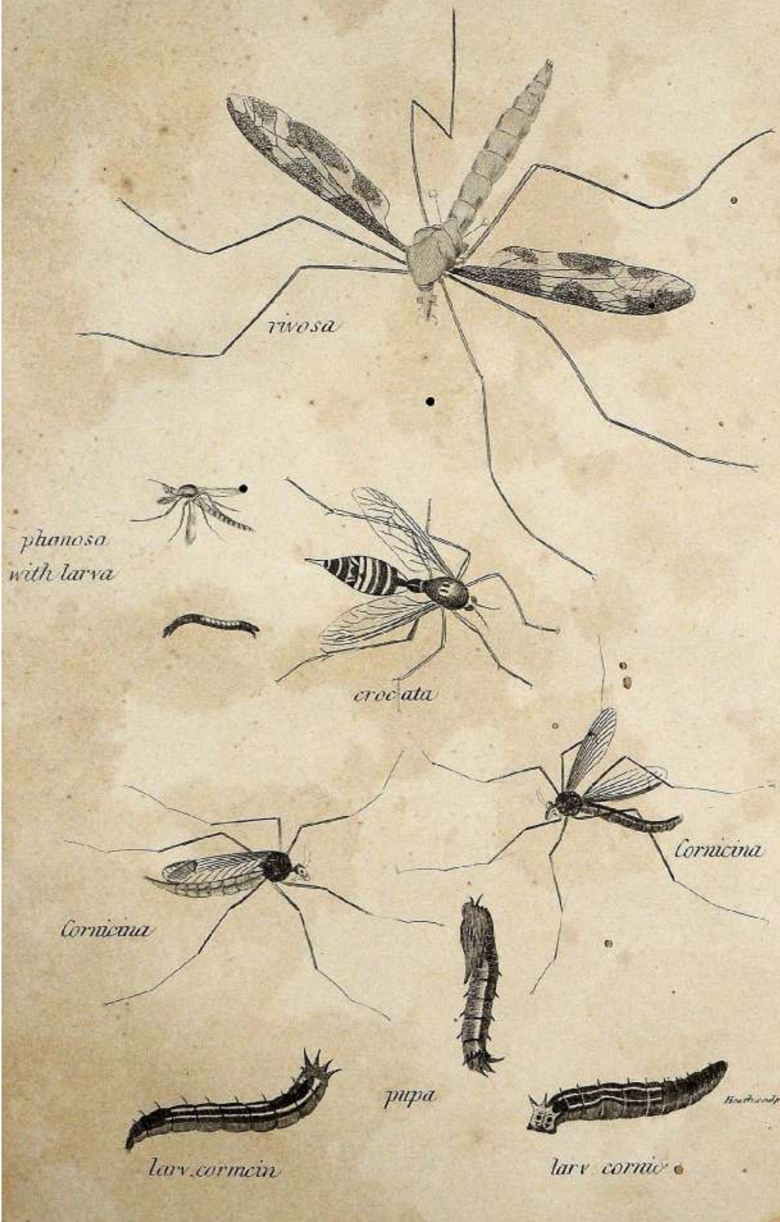
"Providence, (says Mr. Bruce) from the beginning it would seem, had fixed its habitation to one species of soil, being a black fat earth, extraordinary fruitful as it was, it seems from the first to have given a law to the settlement of the country. It prohibited absolutely those inhabitants of the fat earth, called Mazaga, domiciled in caves and mountains, from enjoying the help or labour of any beasts of carriage. It deprived them of their flesh and milk for food, and gave rise to another nation, whose manners were just the reverse of the first. These were the shepherds, leading a wandering life, and preserving these immense herds

of cattle by conducting them into the sands beyond the limits of the black earth, and bringing them back again when the danger from the insect was over."

"We cannot read the history of the plagues which God brought upon Pharaoh by the hands of Moses, without stopping a moment to consider a singularity, a very principal one, which attended this plague of the Fly. It was not till this time, and by means of this insect, that God said, he would separate his people from the Egyptians. And it would seem that then a law was given to them that fixed the limits of their habitation. It is well known, as I have repeatedly said, that the land of Goshen or Geshen, the possession of the Israelites, was a land of pasture, which was not tilled or sown, because it was not overflowed by the Nile. But the land overflowed by the Nile was the black earth of the valley of Egypt, and it was here that God confined the flies; for he says it shall be a sign of this separation of the people, which he had then made, that not one fly should be seen in the sand or pasture ground, the land of Goshen, and this kind of soil has ever since been the refuge of all cattle emigrating from the black earth to the lower part of Atbara. Isaiah indeed says that the Fly shall be in all the desert places, and consequently the sands; yet this was a particular dispensation of providence, to answer a special end, the desolation of Egypt, and was not a repeal of the general law, but a confirmation of

it; it was an exception, for a particular purpose, and a limited time."

Mr. Bruce adds that this insect has no sting, but that its motion is more rapid than that of the bee, and resembles that of the Gad-Fly in England; and that there is something particular in its sound or buzzing. It is a jarring noise, together with a humming, which induces Mr. Bruce to suppose that it proceeds, at least in part, from a vibration made with the three hairs at the snout. He observes farther, that the Chaldee version is content with calling this animal simply *Zebub*, which signifies the Fly in general, as we express it in English. The Arabs call it *Zimb* in their translation. The Ethiopic translation calls it Tsaltsalya, which is the true name of this particular fly in Geez, and was the same in Hebrew.



1803 Octr 1st London Published by G Kearsley Fleet Street.

TIPULA. TIPULA.

Generic Character.

Os capitis elongati maxilla superiore fornicata.	*Mouth* arched over by the upper jaw extended from the head.
Palpi duo recurvi, capite longiores.	*Palpi* two recurved, longer than the head.
Proboscis recurvata, brevissima.	*Proboscis* recurved, very short.

THE larger kinds of Tipulæ are, in general, distinguished by their lengthened bodies, horizontally expanded wings, and the unusual length and slenderness of their legs, which are also remarkably fragile; it being difficult to handle the insect without breaking some of its limbs. The smaller kinds have incumbent wings, and in habit or general appearance are much allied to Gnats, and some are so very small as scarcely to exceed the tenth of an inch in length. The larvæ of this genus differ in habit, according to their different modes of life, some being terrestrial, and others aquatic: they feed on the softer kind of vegetable substances, as the fine fibres of roots, &c. &c.

The largest of the European Tipulæ is the *Tipula rivosa* of Linnæus, often measuring more than an inch and half in body, and is distin-

guished by the colour of its wings, which are transparent, with large dusky undulations intermixed with white towards the rib or upper edge. This insect proceeds from a dusky or greyish larva of a lengthened form, and destitute of legs: it is found beneath the roots of grass in meadows, gardens, &c. and in the months of July and August changes into a lengthened and pointed chrysalis of a dusky colour, out of which in September proceeds the complete animal. This is popularly known by the title of Long-Legs, and is frequently seen in houses during the autumnal evenings, when it is remarkable for the propensity, in common with many other insects, of flying towards the flame of candles, and in consequence, often perishing in the blaze.

Tipula hortorum, or the Garden Tipula, is of somewhat smaller size than the preceding, and is produced from a larva and chrysalis of similar appearance with those of the former kind, but of a darker or blacker colour: the larva is found under grass-roots, &c. The wings of this species are transparent, with obscurely-marked whitish variegations.

Tipula oleracea is a very common species, of nearly similar size with the preceding, and with transparent wings with a dusky rib or upper edge. Its larva inhabits garden-grounds, where it commits ravages among various plants: in its appearance it resembles those of the former kinds. It may be added, that the chrysalis, in most of the terrestrial insects of this tribe is furnished at the

upper part, with a pair of short, horn-like processes, perhaps operating as a kind of spiracula: this particularity is however still more striking in those which belong to the aquatic kinds.

The *Tipula cornicina* is of middle size, and has transparent wings with a marginal dusky spot, and the body yellow, with three longitudinal dusky streaks. Its larva, which is found in meadows, &c. is brown, with a flattened or truncated tail, beset with a certain number of radiating soft spines or processes, and the chrysalis is slender, and furnished, as in most others, with minute spines about its segments, by the assistance of which it is enabled to elevate itself to the surface when the time of its ultimate change takes place.

Tipula crocata is one of the few insects of this genus adorned with lively colours: it is of a polished black, with yellow rings round the abdomen.

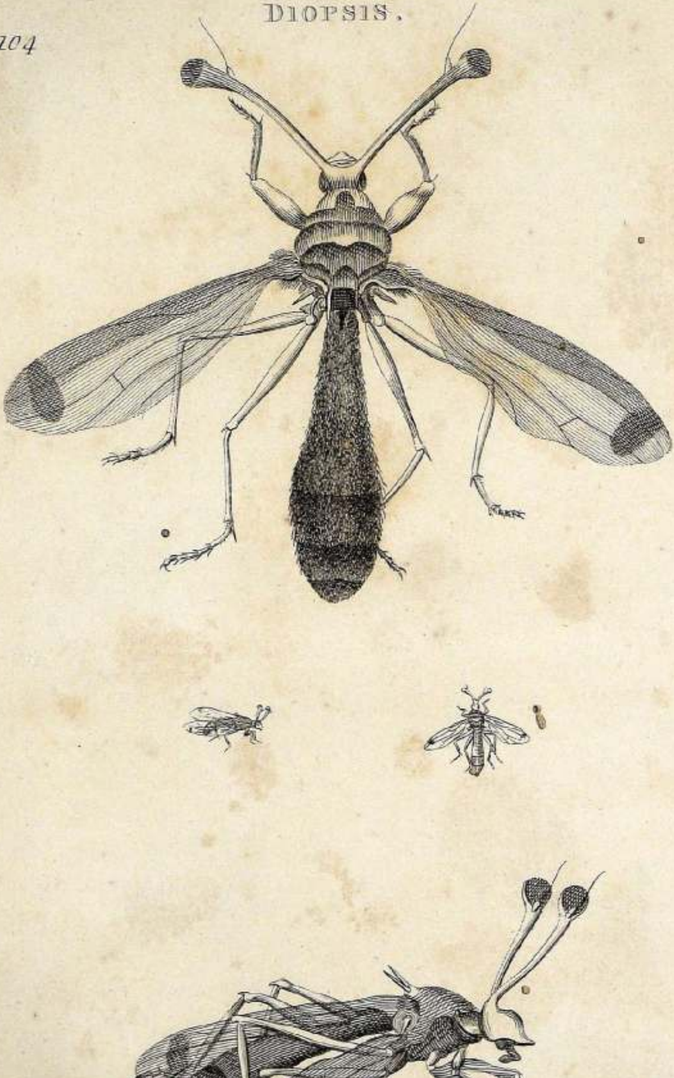
Of those in which the wings are generally incumbent, the *Tipula plumosa*, so named from its plumed antennæ, may serve as an example. This insect is of the size of a Gnat, which it so much resembles in its general appearance as to be frequently mistaken for one: its colour is a greenish brown. The larva is aquatic, bears a considerable resemblance to those of the genus Culex, as does likewise the chrysalis or pupa, which, instead of lying dormant during this state, is locomotive, playing about in the water, like the larva, and, at the time of its change, springs to the surface in order to give birth to the complete insect.

Among the very small Tipulæ none is more fa-

miliar than the elegant species called by Linnæus *Tipula phalænoides.* This minute fly is very frequently observed in great numbers on windows during the decline of summer, appearing principally in the evening. It has so little the appearance of a genuine Tipula, that it would hardly be considered as belonging to this genus by a common spectator. Its general length is about the tenth of an inch, and the wings, which are very large in proportion to the insect, are of an oval shape, and of a grey colour, elegantly mottled or variegated with dusky specks: the edges are deeply fringed with hair, and the nerves beset with oblong scales or feathers, and the whole insect, microscopically examined, exhibits a highly elegant appearance.

Tipula hirta so much resembles the last, that it might perhaps be rather considered as a variety or sexual difference than truly distinct: it is however a trifle larger and of a darker colour. There can be little doubt that the Larvæ of these minute species are aquatic, but they seem to be hitherto undescribed.

DIOPSIS.



Heath sculp.

D. ichneumonea in its nat. size & magnified.

1805. Oct. 1 London. Published by G. Kearsley Fleet Street.

DIOPSIS. DIOPSIS.

Generic Character.

Antennæ minimæ, setaceæ.	*Antennæ* very small, setaceous.
Oculi pedunculati; pedunculis longissimis.	*Eyes* situated on very long footstalks.

THE genus Diopsis, which has no place in the twelfth edition of the Systema Naturæ, was instituted by Andrew Dahl, a pupil of Linnæus, in an entomological dissertation published at Upsal in the year 1775. The only species hitherto discovered is the *Diopsis ichneumonea*, a small insect of about the size of an Ant, and highly remarkable for the singular appearance of the eyes, which appear seated at the tips of a pair of long styles or processes, at first sight resembling antennæ. The general colour of the animal is rufous brown, with the thorax and extremity of the body darker, or blacker than the other parts: on the hind part of the thorax are placed two spines in the middle, and one on each side: the wings are transparent, each marked towards the upper part of the tip by a black spot. The insect is said to be a native of Guinea.

MUSCA. FLY.

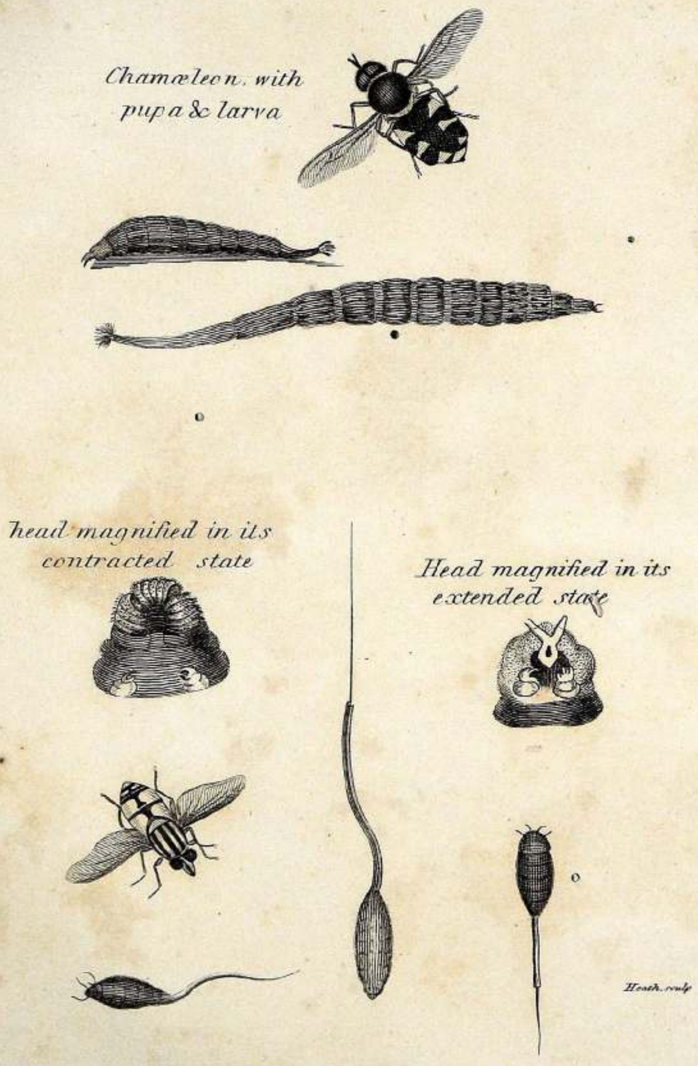
Generic Character.

Os proboscide carnosa, labiis duobus lateralibus.	*Mouth* formed intô a fleshy proboscis, with two lateral lips.
Palpi nulli.	*Palpi* none.

THE vast extent of the genus Musca makes it necessary to divide the whoie into different assortments, in order to the more ready investigation of the species. These divisions are instituted from the form of the antennæ, which are either simple, (without any lateral hair or plume;) or armed, (that is, furnished with a lateral hair or plume.) These divisions are farther separated into others, according to more or less downy or hairy appearance of the insects.

The first section of this genus comprehends such Flies as have simple antennæ.

The Larvæ, in the different tribes of Flies, differ far more in habit than the complete insects; some being terrestrial, and others aquatic. Those of the more common kinds are emphatically distinguished by the title of Maggots, and spring from eggs deposited on various putrid substances. Several of the aquatic kinds are of singularly cu-



pendula, with larva & pupa

1805, Octr 1 London. Published by G. Kearsley, Fleet Street.

rious formation, and exhibit wonderful examples of the provision ordained by Nature for the preservation of even the meanest and most seemingly contemptible of animals. Several are inhabitants of plants, feeding during this state on other living insects.

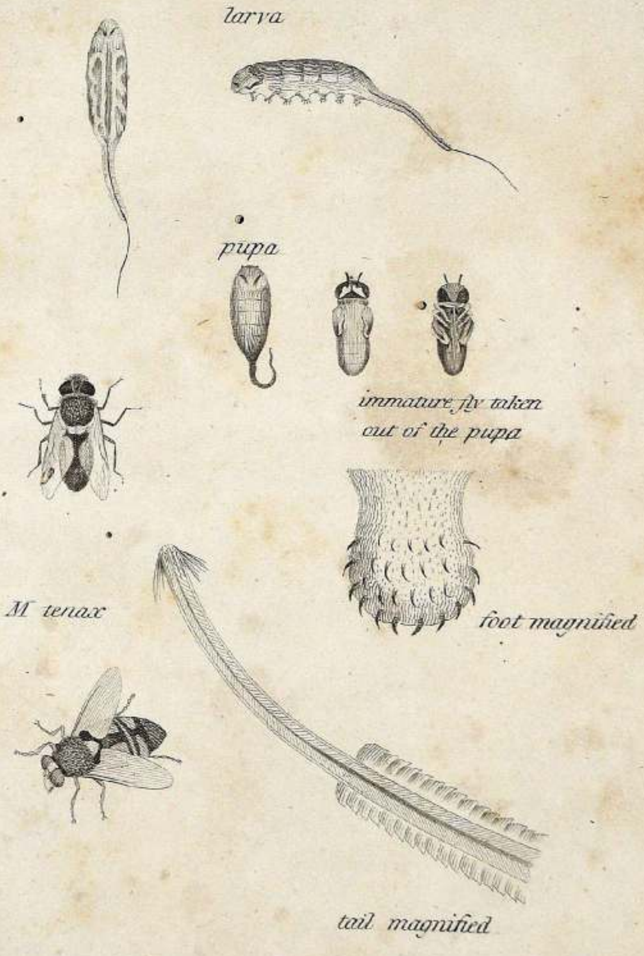
The general form of the Chrysalis or Pupa is that of an oval, differently modified, according to the species, and formed by the external skin of the larva, which hardens round the chrysalis. Some species however cast their skin before their change into the pupa state.

In this division one of the most remarkable species is the *Musca Chamæleon*, which is a large black Fly, with a broad, flattish abdomen, having the sides of each segment yellow, forming so many abrupt semi-bands across that part. It proceeds from an aquatic larva, of very considerable size, measuring two inches and half in length; of a somewhat flattened shape, and of a brown colour, with a narrow or slender front, the body widening by degrees towards the middle, and from thence gradually tapering to the extremity or tail, which is terminated by a circle of radiating or diverging hairs. This larva is common in stagnant waters during the summer months, and passes into its chrysalis state without casting its skin, which dries over it, so as to preserve the former appearance of the animal in a more contracted state.

In this division also stands the *Musca Vermileo*, a middle-sized Fly, of a somewhat lengthened

form, with a distant resemblance to a Tipula: it is of a dull yellow colour, with transparent wings; the thorax marked above by two black lines, and the abdomen by a triple series of black spots. The larva of this species measures about three quarters of an inch in length, and is of a pale yellowish grey colour; slender or sharpened in front, and growing gradually broader towards the tail. It is found in the Southern parts of Europe, and is not uncommon in some districts of France, and is remarkable for practising a method exactly similar to that of the Hemerobius Formicaleo in order to obtain its prey; excavating a circular pit or cavity in the dry sand; concealing itself beneath the centre, and thus waiting the arrival of any small insect which may happen to fall into it, and after absorbing its juices, throwing out the exhausted remains to a considerable distance from the verge of the cavity. This larva seems to have been first observed and described by Reaumur, in the Memoirs of the French Academy for the year 1752. It assumes the state of a chrysalis by casting its skin, which rolls to the hinder part of the body: the chrysalis is of a dull reddish colour, and is rounded or clubbed at the upper part, suddenly tapering from thence to the extremity, and after lying nine or ten days, gives birth to the included insect.

Of the Downy, or slightly hairy Flies with bristled antennæ one of the most remarkable is the *Musca tenax*, which is about the size of a Drone, and of a brown colour, with transparent



Heath sculp

1805 Oct. 1 London Published by G. Kearsley, Fleet Street.

wings, and the first segment of the abdomen yellowish on each side. It proceeds from a larva of a very singular appearance, being a long-tailed brown maggot, of rather slow motion, measuring about three quarters of an inch in length, exclusive of the tail, which is extensile, and consists of a double tube, the exterior annulated into numerous segments, and the interior slender, and terminated by a circle of hairs, surrounding a spiraculum or air-hole. This maggot is seen in muddy stagnant waters, drains, and other places of the dirtiest description; and notwithstanding its unpleasing appearance, exhibits, when accurately examined, many particulars well worthy of admiration: the feet in particular, which are seven in number on each side, are wonderfully calculated for enabling the animal to ascend walls or other perpendicular places, in order to seek some proper situation in which it may undergo its change into chrysalis, being very broad, and beset on their under surface with numerous, small, hooked claws; giving it the power of clinging with security during its ascent.

Of this larva a particularity is stated, on the authority of Linnæus, which, if true, may indeed well be numbered among the *Miracula Insectorum;* (the title of the paper in the *Amoenitates Academicæ*, in which it is announced,) viz. that being a frequent inhabitant of the turbid pulp used in the operation of paper-making, it is often exposed to the action of the wooden mallets used in the process, as well as squeezed in the strongest

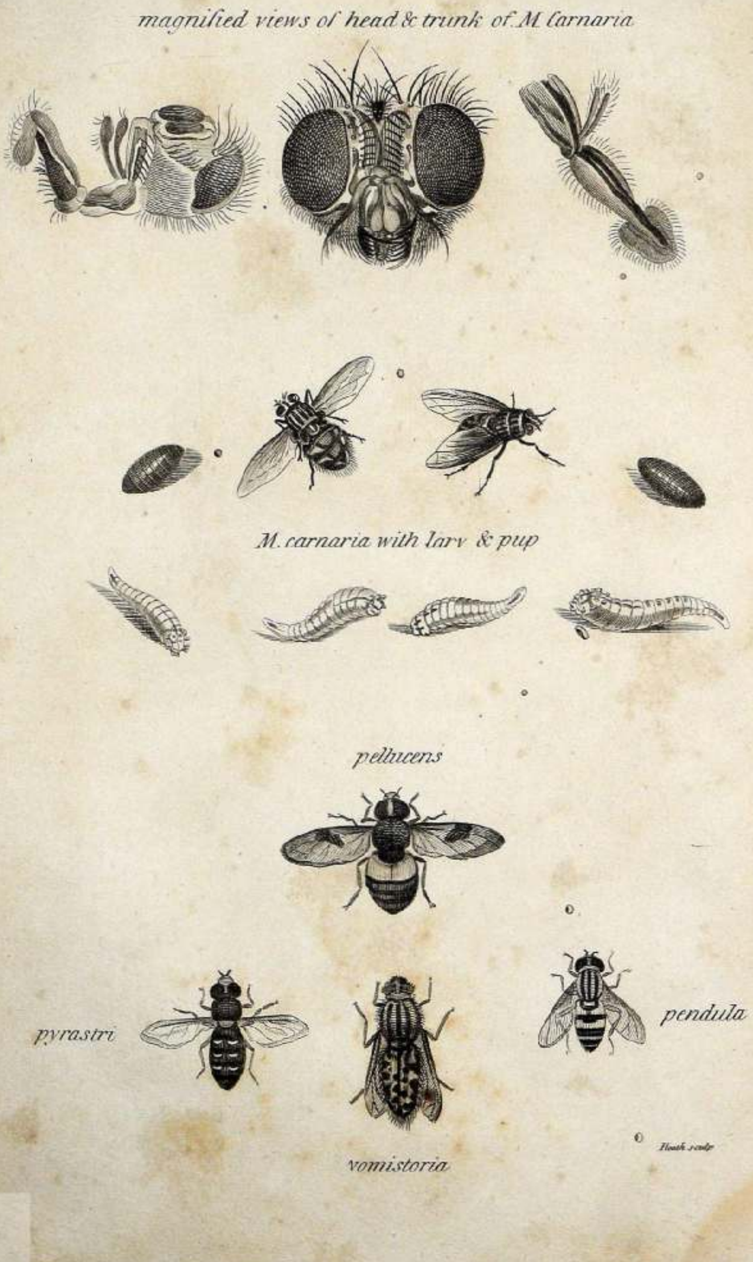
presses; and yet survives uninjured these seemingly destructive operations!!! That I may not seem to do injustice to the author by carelessly quoting his observation, I shall here give it in his own words. " Musca tenax mira pollet proprietate, quæ possibilitati physicæ repugnare videtur. Larva enim quæ inter ramenta papyracea aquæ immersa, dum pappus conficitur a bibliopegis, malleis ligneis tunditur & fortissimo prelo comprimitur, incolumis tamen vivit." *Am. Acad.* 3. *p.* 331.

This is confirmed in the Systema Naturæ, where we find the observation " *Larva tenacissima, vix prelo destruenda,*" which is also repeated by Fabricius in his *Species Insectorum.*

The above larva commonly changes to a chrysalis about the end of August; the skin contracting, and drying round the body, and the tail continuing, in a shrivelled state. After thus remaining about the space of a fortnight, it gives birth to the complete insect, which has so much the general appearance of a Drone that it is very frequently mistaken for such. It is extremely common during the month of September.

Musca pendula, which belongs also to this division in the genus, is a moderately large, and very beautiful insect. Its colour is black, with four bright yellow stripes down the thorax, and three broad, interrupted bars across the abdomen; or, in other words, this Fly might be described as of a bright yellow colour, with the thorax marked by four longitudinal black lines, and the abdomen by three transverse ones, connected by a black stripe

MUSCA.



1803 Oct. 1st London Published by C. Kearsley Fleet Street.

down the middle. Its larva, which is an inhabitant of stagnant waters, is of a still more remarkable appearance than that of the immediately preceding species, which it resembles in size, but is of a paler colour, and furnished with a tail of greater length, composed of a double tube, the interior of which is very slender, extensile at the pleasure of the animal, to a vast length, and terminated by a very small spiracle. The length of this tube is therefore varied according to the greater or smaller depth at which the insect chuses to continue; the tip reaching to the surface, in order to supply the requisite quantity of air. Sometimes great numbers of these maggots are found coiled or twisted together by their tails, in such a manner that it is by no means easy to separate any one from the rest. The Chrysalis resembles that of the *Musca tenax*, the remains of the tail being visible in a dried and contracted state. The complete insect is frequently seen on flowers during the autumnal season.

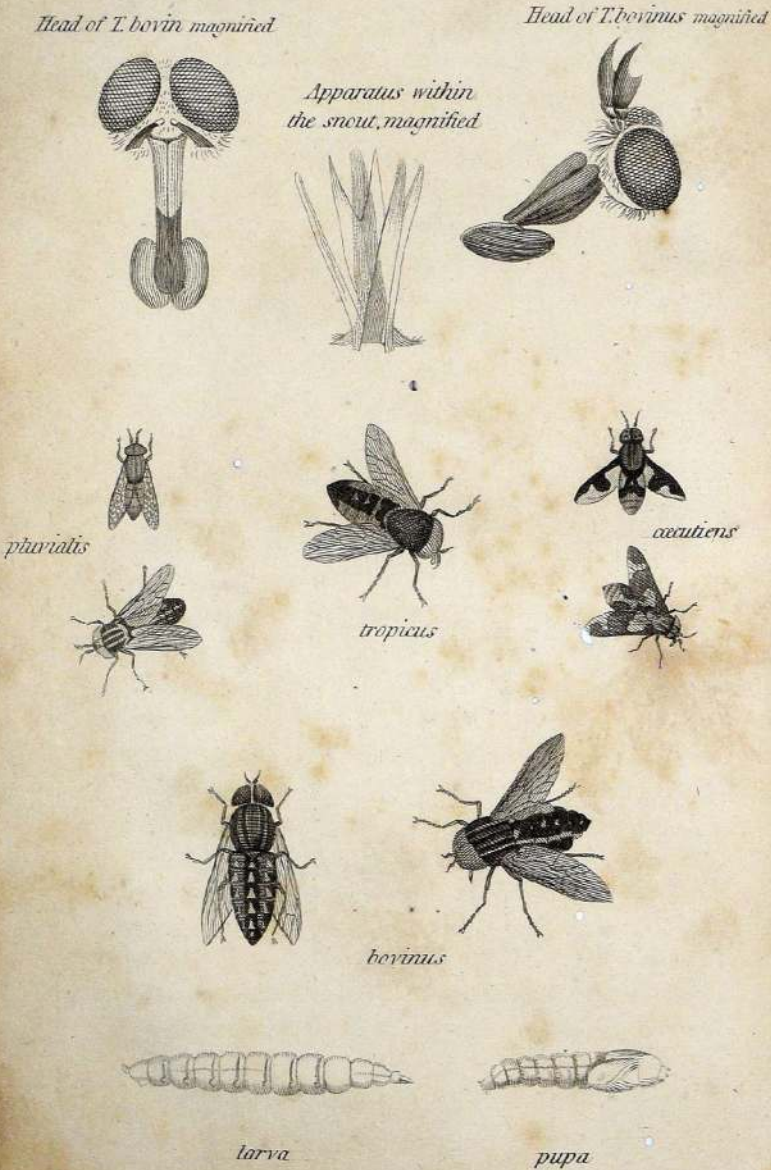
Among the hairy or bristly Flies with plumed antennæ stands the well known species called *Musca carnaria**, or the common large Blow-Fly. This, as every one knows, deposits its eggs on animal flesh, either fresh or putrid. The larvæ or maggots hatch in about the space of a few hours, and when full grown, which happens in eight or ten days, are of a white or yellowish

* Musca vomitoria. Lin.

white colour with a slight tinge of pale red, and of a lengthened shape, with a sharpened front, in which the mouth is situated, and from whence the body gradually enlarges in size to the last or terminal segment, which is of a very broad and flattened form, surrounded by several slightly prominent tips, and furnished with a pair of dusky specks resembling eyes; so that an inaccurate spectator might easily mistake this part for the head and the proper head for the tail. When the animal changes to a chrysalis, the skin dries round it, and the whole assumes a completely oval form, and a reddish colour, soon changing into a reddish brown. In ten days more the Fly itself emerges, which is too well known to require particular description.

Musca vivipara greatly resembles the preceding, and is found in similar situations, but is viviparous, disclosing small ready-formed larvæ instead of eggs, which in this species are hatched internally. This particularity is not confined to the present species, but has been observed in some others of this genus.

To this as well as the preceding has been applied the observation *Tres muscæ consumunt cadaver equi æque cito ac leo;* the number of larvæ proceeding from the flies, and the quick evolution of the successive broods destroying the same quantity of flesh in a given time as the predacious quadruped, who devours a great quantity at certain intervals only; while the process of destruc-



1805 Octr 1 London, Published by G. Kearsley, Fleet Street.

tion continues with unremitted perseverance on the part of one or other of the respective races of the Flies.

Of the hairy Flies with bristled antennæ, the *Musca grossa*, the largest of all the European Flies, affords a good example. It is considerably larger than the largest blow-fly, and is of a black colour, with the wings dull orange-coloured at their base. In its general appearance it greatly resembles the Musca meridiana, which is similar in colours, but stands in a different division in the genus, viz. among the hairy flies with plumed antennæ.

Musca flava is one of the smallest but most elegant of the European flies, and is not very uncommon during the autumnal season, being observed in gardens and in windows. It is about the eighth part of an inch in length, and of a yellow colour with bright gold-green eyes.

TABANUS. TABANUS.

Generic Character.

Os proboscide carnosa, terminata labiis duobus.	*Mouth* formed into a fleshy proboscis, terminated by two lips.
Rostro palpis duobus subulatis, proboscidi lateralibus, parallelis.	*Rostrum* furnished with two pointed palpi, placed on each side of, and parallel to the proboscis.

In general appearance or habit these insects bear an extreme resemblance to those of the preceding genus. The largest of the British species is the Tabanus bovinus of Linnæus, having the appearance of a very large* grey or pale-brown Fly, marked down the back by a series of large, whitish, triangular spots, pointing downwards: on each side also is an approach to a similar appearance, though less distinct than that of the dorsal row. This insect, like the rest of its genus, is seen during the middle and the decline of summer; generally in the hottest part of the day. It is extremely troublesome to cattle, piercing their

* Often measuring near an inch in length.

skin with the lancets of its trunk, and sucking the blood in such a manner as to cause considerable pain. It proceeds from a large, dusky-yellowish larva, nearly resembling that of a Tipula, and marked by transverse blackish streaks or rings: it resides under-ground in moist meadows &c. and changes to a cylindric, brownish chrysalis, with a roundish or very slightly pointed extremity; out of which, in the space of a month, proceeds the perfect insect.

Tabanus tropicus is of smaller size than the preceding, and of a brown colour, with the sides of the abdomen bright ferruginous. It is a less common species than the former.

Tabanus pluvialis is of the size of a window fly, but of a somewhat longer shape in proportion: it is of a dull brown colour, with the wings of a similar case, but marbled or variegated with very numerous whitish specks: this is a very troublesome insect during the latter part of summer, fastening on the legs, hands, &c. and causing considerable pain by the puncture of its proboscis: it is observed to be peculiarly teasing on the approach of rain.

Tabanus cæcutiens is an insect of singular beauty. It is of the size of a common window fly, and of a yellowish brown colour varied with black; the wings are transparent, and marked by large black bands or patches, and the eyes are of the most vivid or lucid green, marbled with black spots and streaks. It is by no means uncommon during the autumnal season.

CULEX. GNAT.

Generic Character.

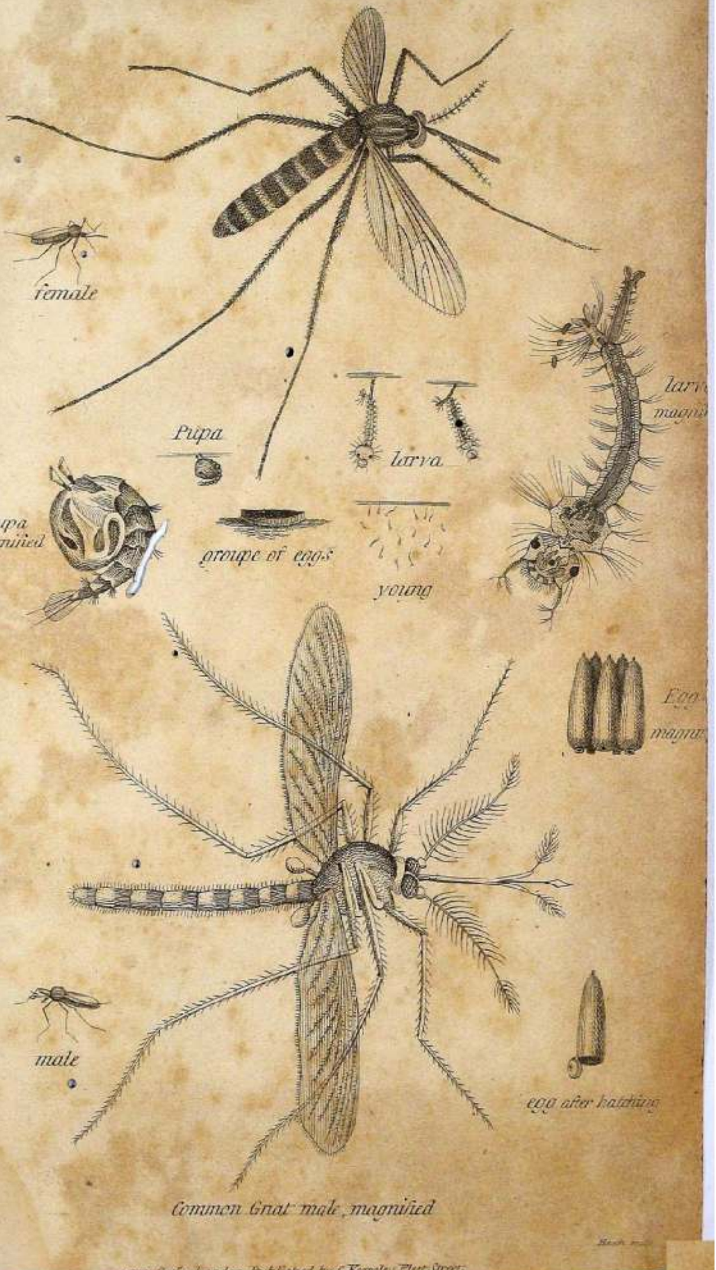
Os aculeis setaceis intra vaginam flexilem.	*Mouth* consisting of setaceous piercers within a flexible sheath.

THAT well-known insect the common Gnat is produced from an aquatic larva of a very singular appearance, and which, when first hatched from the egg*, measures scarcely more than the tenth of an inch in length. In the space however of fourteen days it arrives at the length of something more than half an inch. In this state the head is very large, and furnished on each side with a pair of jointed processes resembling antennæ; the thorax large and angular; the body suddenly lessening from this part, and continuing of nearly equal diameter to the tail, which is of an abruptly truncated figure, and tipped with four foliaceous processes: before the setting on of the tail is a long, tubular, projecting process, nearly at a right

* The eggs of the Gnat are deposited in close-set groupes of three or four hundred together, and are very small, of a brown colour, and of a cylindric shape with pointed tips: the whole groupe is placed on the surface of the water, close to the leaf or stalk of some water-plant.

CULEX.

Common Gnat female, magnified



Common Gnat male, magnified

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angle from the abdomen, and terminating in a tubular opening, verged by four ovate scales, two of which exceed the rest in size: the whole animal is of a brownish colour, semitransparent, and beset on each side the head, body, and tail, with large tufts of hair: its motions are very lively, and are conducted with a kind of convulsive rapidity, in different directions, and to a small distance at a time. It feeds on the minute vegetable and animal particles which it finds in plenty in the stagnant waters in which it resides, and, when arrived at its full growth, casts its skin, and commences chrysalis, the aspect of which is hardly less singular than that of the larva, the head and thorax appearing connate, and exhibiting a large oval mass at the upper part of the animal, while the body bends downwards beneath: the thorax is furnished on each side with an upright short tube or spiracle, and it is from these parts that the animal frequently hangs suspended from the surface of the water: the tail is tipped with a pair of leaf-shaped processes. This chrysalis, like the larva from which it proceeded, is loco-motive, springing about in the water nearly in a similar manner. When ready to give birth to the included Gnat, which usually happens in the space of three or four days, it rises to the surface, and the animal quickly emerges from its confinement.

The Gnat is supposed to feed both on animal and vegetable juices, but perhaps chiefly on the latter, since, as Reaumur observes, of the millions on millions which swarm in the marshy re-

gions where they are evolved, it can rarely fall to the lot of one in an hundred to taste blood once in its life.

The inconveniences, and even torments, experienced from these insects in some parts of the world are hardly to be conceived by those who inhabit the more favoured regions of the European continent. Instances have often been known to occur of persons whose faces or limbs have been thrown into such a severe inflammation as even to threaten the most serious consequences.

A warm, rainy season, is most favourable to the evolution of Gnats, and, in such summers, particular districts in most countries are occasionally pestered by their legions. In the Philosophical Transactions for the year 1767 we have an instance of this kind in the neighbourhood of Oxford, communicated by the late learned Mr. Swinton of that University.

Oxford, Nov. 15, 1766.

"The Gnats have been more numerous, as well as more noxious here, during the months of July, August, and September, 1766, than perhaps they were ever known before in the memory of man. So many myriads of them have sometimes occupied the same part of the atmosphere, in contiguous bodies, that they have resembled a very black cloud, greatly darkened the air, and almost totally intercepted the solar rays. The repeated bites likewise of these malignant insects have been so severe, that the legs, arms, heads, and

other parts affected by them, in many persons, have been swelled to an enormous size. The colour also of these parts, at the same time, was red and fiery, perfectly similar to that of some of the most alarming inflammations."

Mr. Swinton adds that the swarms of these animals were observed to ascend in columns of at least fifty or sixty feet in height.

But of all the European nations that of Lapland seems to be the greatest sufferer from these vexatious animals, which, during the heats of the short summer, fill the air with such swarming myriads, that the poor inhabitants can hardly venture to walk out of their cabins, without having first smeared their hands and faces with a composition of tar and cream, which is found by experience to prevent their attacks. Yet even this seemingly unfavourable circumstance may be considered, in another point of view, as constituting one of the advantages of the country, being, in the expressive words of Linnæus "*Lapponum calamitas felicissima;*" since the legions of larvæ which fill the lakes of Lapland form a delicious and tempting repast to innumerable multitudes of aquatic birds; and thus contribute to the support of the very nation which they so strangely infest.

It may be added that the formidable insect called the Musquito, so much dreaded by the inhabitants of the West-Indies, and America, where its bite seems to operate with peculiar malignity, is supposed to be no other than a variety of the common European Gnat, which derives additional

vigour from the warmer and moister atmosphere of the regions of the Western Hemisphere.

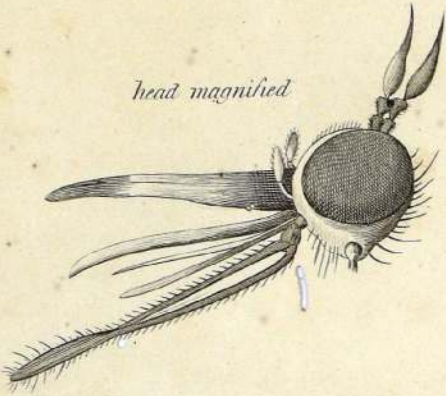
The true structure of the proboscis or piercer of the Gnat, which, in its immediate operation, produces no very acute pain, but which is so often succeeded by such troublesome consequences, is not very easily determined. It seems however to consist of an external scaly sheath or tube, longitudinally divided by a continued slit, and so flexible as to be conveniently doubled or bent in a greater or less degree while the secondary or included tube is in the act of absorption. This secondary or included tube appears to consist of five parallel, linear parts, forming by their junction or juxtaposition a firm, yet exquisitely fine sucker, which is forced into the skin of the animal attacked by the Insect. The swelling which takes place after the bite must be supposed to be owing to some acrimonious fluid injected into the punctured part, and which may cause the blood to flow with greater facility into the proboscis during the time that organ is employed.

Culex pulicaris, or Midge, is a much smaller species, and is distinguished by having the wings marked by three dusky spots.

Culex reptans is also a very small insect, and is of a black colour, with transparent wings, and the legs marked by a white bar. It is particularly troublesome in marshy districts during the evening, by its creeping motion on the skin of the face, &c.

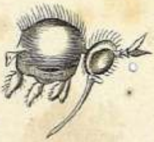
EMPIS.

head magnified



livida

borealis



head magnified

Heath sculp.

1805 Oct.r 1st London Published by G. Kearsley Fleet Street.

EMPIS. EMPIS.

Generic Character.

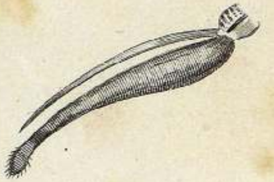
Os rostro corneo, inflexo, bivalvi, thorace longiore; valvulis horizontalibus.	*Mouth* with a horny, inflected, bivalve snout, longer than the thorax, with horizontal valves.

In point of habit the insects of the genus Empis bear some resemblance to those of Tipula and Culex. One of the most familiar species is the *Empis livida* of Linnæus, which is a brownish fly, with the thorax marked by three longitudinal black lines: the legs are rufous or ochre-coloured, and the feet blackish: the wings are transparent, with dark veins. These insects are observed in fields and gardens. Degeer informs us that in the year 1773 vast numbers of this species were observed on the ears of rye in some parts of Sweden, and were believed by the people to have considerably injured the crops; but this he considers as an unfounded notion. They principally feed on the smaller kind of flies, &c.

Empis borealis is of a more slender form than the common window fly, and of a blackish colour, with very large, broad, oval wings, of a brown colour, and rufous legs, varied with black. It is observed in similar situations with the preceding.

CONOPS.

snout magnified



calcitrans head magnified

aculeata with head magnified

rostrata, with head magnified

Heath, sculp

1805. Octr 1 London, Published by G. Kearsley, Fleet Street.

CONOPS. CONOPS.

Generic Character.

Os rostro porrecto, geniculato.	*Mouth* with a porrected, jointed snout.

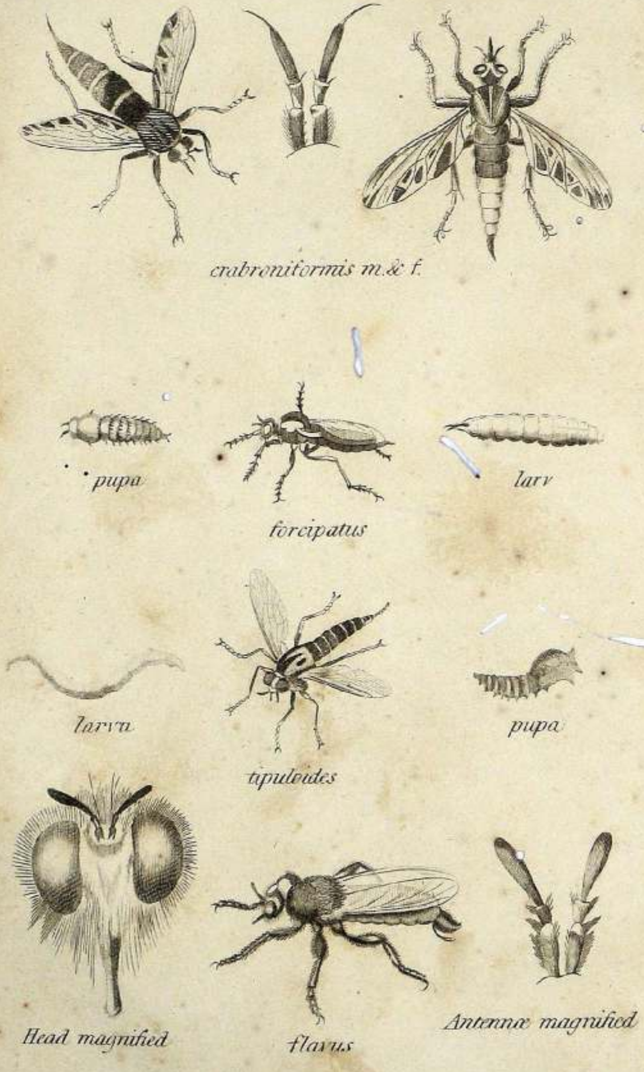
Of this genus the most common species is the *Conops calcitrans* of Linnæus, remarkable for its extreme similitude to the common window-fly, for which it is very frequently mistaken, but, if closely examined, will be found to be clearly distinguished by its strong and pointed proboscis, stretching forwards from an elbow or joint at its lower part. This insect, during the autumnal season, is very troublesome both to men and cattle, causing a sharp or pungent pain by the insertion of its proboscis, while in the act of sucking blood. It is, according to Linnæus, the principal cause of the wincing and kicking motion so frequent in horses during the heat of the day. Like the Tabani and some other flies it is most troublesome on the approach of rain.

Conops irritans Lin. much resembles the preceding, but is not much more than half its size: its habits are the same; causing uneasiness to cattle

while feeding, and, according to Linnæus, proving beneficial to them by inducing a continual motion, and thus preventing them from perishing by indolence and repletion!!!

Conops rostrata is of the size of a window-fly, and is black, with a yellow abdomen, and a strong, conic snout, the base being thicker than in other insects of the genus.

ASILUS.



Heath sculp.

1805 Octr. 1st London Published by G Kearsley Fleet Street.

ASILUS. ASILUS.

Generic Character.

Os rostro corneo, porrecto, recto, bivalvi.	*Mouth* with a strait, horny, bivalve snout.

THE most common European species of Asilus is the *Asilus crabroniformis*, a moderately large insect, nearly equalling a Hornet in length, but of a much more slender and sharpened form: the head and thorax are of a ferruginous colour: the eyes black: the upper half of the abdomen velvet-black, the lower half bright orange-colour, the whole having a bright silky or downy surface: the wings are dull yellow-brown, semi-transparent, and marked on their inner edge by several dusky triangular dashes or spots, with the bases towards the edge of the wing.

Though of a somewhat formidable aspect, this insect is incapable of piercing with any degree of severity. It preys on the smaller kind of insects, and proceeds from a smooth, yellowish-white, subterraneous larva, of a lengthened shape, and destitute of legs: the pupa resembles that of a Tipula.

The *Asilus gibbosus* is a larger species, nearly

equalling a hornet in thickness as well as in length, and is entirely of a deep-black colour, with the three terminal segments of the abdomen white: the whole is accompanied by a silken lustre as in the preceding species; the front of the head is of a greyish cast. This species is a native of the northern parts of Europe and occurs in Lapland.

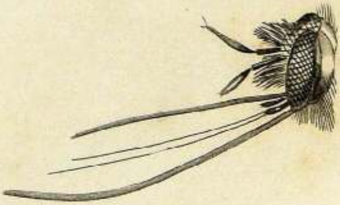
Asilus flavus is of the size of a Wasp, and of a black colour, but covered with shining down, which on the thorax is grey, and on the abdomen orange-yellow.

Asilus forcipatus is considerably smaller than the preceding, and is of a blackish brown colour, with the sides of the abdomen yellowish: the tail of the male is forcipated; that of the female simple.

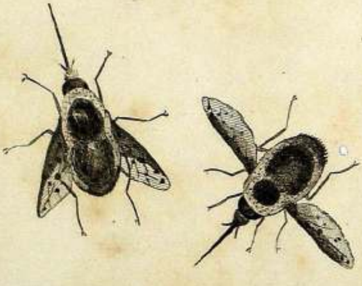
Asilus tipuloides is one of the smaller species, and is of a grey colour, with three black lines down the thorax.

BOMBYLIUS.

head magnified



B. major



B. medius

Heath sculp

1805, Oct. 1 London, Published by G Kearsley, Fleet Street

BOMBYLIUS. BOMBYLIUS.

Generic Character.

Os rostro porrecto, setaceo, longissimo, bivalvi: valvulis horizontalibus intra quas aculei setacei.	*Mouth* furnished with a very long porrected, setaceous, bivalve trunk, with horizontal valves including setaceous piercers.

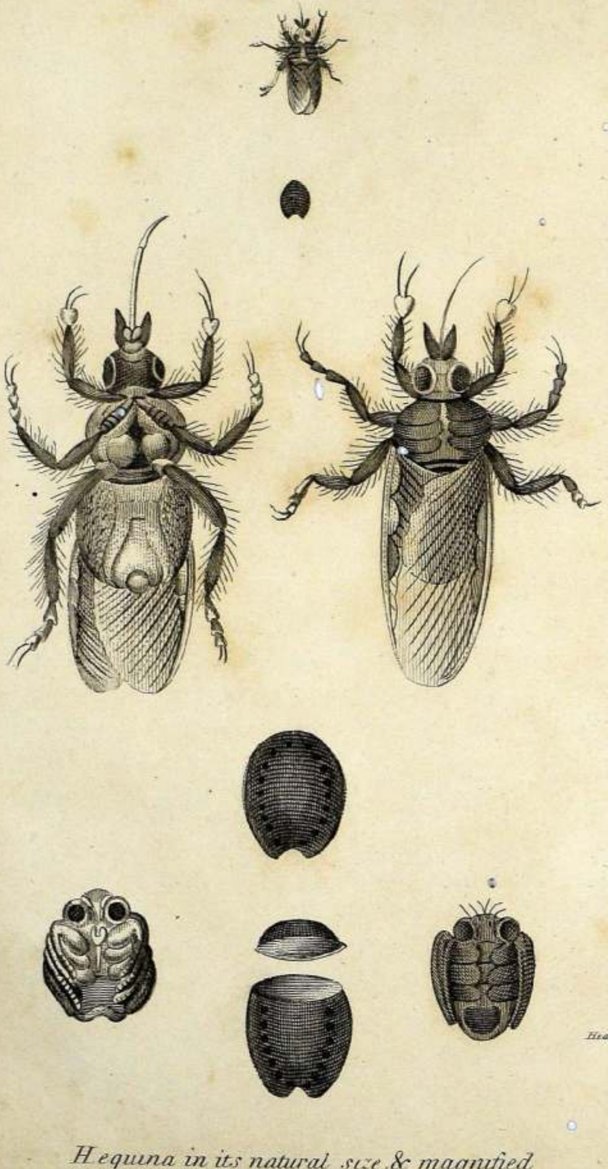
THE insects of the genus Bombylius have an appearance somewhat resembling that of the smaller kinds of Humble-Bees, being thickly covered with erect downy hair: their flight is rapid, and they may be frequently observed to hang as if suspended, over a flower, in the manner of some of the Sphinges or Hawk-Moths, rapidly vibrating their wings, and darting off, on the least disturbance, to a considerable distance. The most common species, the *Bombylius medius*, is often seen, in the early part of Spring, in gardens and fields, and is readily distinguished by its downy bee-like body, and its strait, sharp-pointed proboscis. Its colour is pale chesnut-brown, with whitish-yellow hair; and the wings are blackish along the whole length of the upper half, the re-

mainder being transparent and marked by pretty numerous black spots.

Bombylius major Lin. greatly resembles the above, but is described as having the wings destitute of spots, being only marked by the black upper division: the Linnæan characters however of these two species of Bombylius hardly seem sufficiently distinct.

The genus Bombylius is not very extensive.

HIPPOBOSCA.



H equina in its natural size & magnified

1805. Octr. 1 London Published by G Kearsley, Fleet Street

HIPPOBOSCA. HIPPOBOSCA.

Generic Character.

Os rostro bivalvi, cylindrico, obtuso, nutante.	*Mouth* furnished with a bivalve, cylindric, obtuse, nutant snout.
Corpus depressum.	*Body* depressed.
Pedes unguibus pluribus.	*Feet* furnished with several claws.

THE genus Hippobosca is remarkable for many singularities. It is not an extensive genus; the European Hippoboscæ, so far as our present entomological information reaches, scarcely affording more than five or six distinct species. Of these the most familiar is the *Hippobosca equina*, or Horse-Fly, so troublesome to those animals, as well as to cattle, during the decline of summer, by its irritating motion, (which is performed in various directions with equal facility) and by the pungent pain which its proboscis excites while in the act of suction. In size it varies in different districts, and seems to be largest in the southern climates. It usually however measures something more than a quarter of an inch in length, and is

of a flattened form, with a rounded abdomen, and moderately broad obtuse wings: its colour is a blackish chesnut, with the thorax speckled with white, and the abdomen marked with obscure variegations of a deeper cast: the skin is of a remarkably strong or coriaceous nature, since the insect may be pressed strongly between the fingers without being apparently injured. The female of this insect deposits a single egg at distant intervals, and so very large is the egg as at least to equal, if not in some degree to surpass the size of the abdomen itself of the parent insect*. In reality however, this seeming egg may be rather considered as a pupa, since it undergoes no farther alteration of form: the figure of this precocious pupa is that of an oval, with an excavated depression at the lower end: its colour, at its first exclusion, is milk-white, except a large black spot on the part just mentioned. It continues perfectly inert, and gradually becomes of a brown, and at length, of a polished black colour, and thus commences a genuine or confirmed pupa, which, if opened after a certain period, exhibits the Fly in its unadvanced state and of a white colour. It often lies during the whole winter in this state, the Fly emerging in the succeeding summer.

Hippobosca avicularia much resembles the preceding species, but is considerably smaller, and

* Hippoboscæ ovum matre facile majus, potius Pupa excludenda in volatile. Lin. Syst. Nat.

HIPPOBOSCA.

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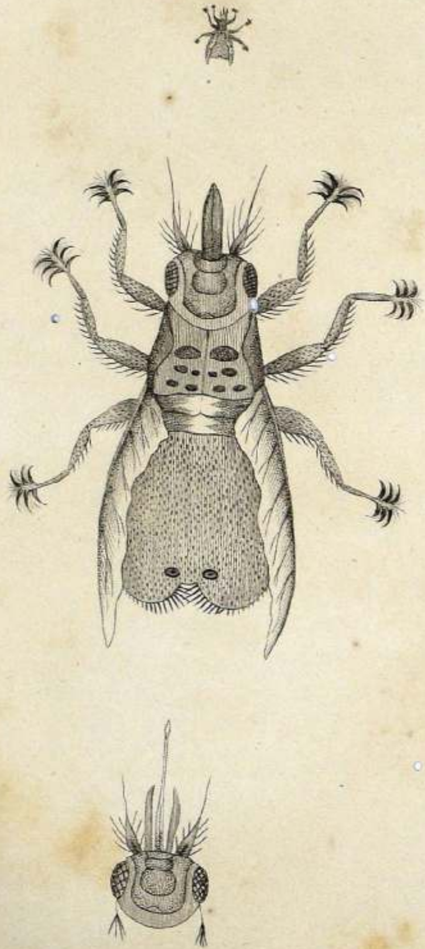


H. Hirundinis.

M Griffith sculp

1805, Oct.r 1, London, Published by G. Kearsley, Fleet Street

of a dull green colour: it is often observed on the bodies of various birds, which it infests in a very troublesome degree.

Hippobosca Hirundinis is equal in size to the H. avicularia, and is of a livid greenish colour, with the abdomen deeply emarginated behind, so as to represent the usual figure of an inverted heart: the wings are of a sharpened or lanceolate form; and the feet, instead of being terminated by two claws only, as in the generality of insects, have six sharp, curved divisions; and though four of these may rather be considered as a kind of spurious claws, yet they still operate as so many real unguiculi, and enable it to adhere with great tenacity. This species is very often observed on the bodies of Swallows, Swifts, and Martins; and may almost always be found in their nests. Its motion, like that of the two preceding kinds, is brisk, but irregular, moving in all directions with equal facility. The egg or pupa of this species is at least as large in proportion to the parent as that of the Horse-Fly: it gradually changes to a jet-black colour, and the complete Fly is usually produced from it in the space of a month.

Hippobosca ovina is commonly known by the name of the Sheep-Tick, and is very frequently found imbedded in the wool of those animals. It is of a reddish-brown colour, and differs from the rest of the genus in being entirely destitute of wings. Its pupa is also of a reddish-brown colour, exactly oval, and of a shining surface.

All the Hippoboscæ are remarkably tenacious of life, and the H. ovina in particular, which may often be observed in wool that has long been packed into fleeces.

INSECTS.

ORDER

APTERA.

LEPISMA. LEPISMA.

Generic Character.

Pedes sex, cursorii.	*Legs* six, formed for running.
Os palpis duobus setaceis et duobus capitatis.	*Mouth* with two setaceous and two headed feelers.
Cauda setosa; setis extensis.	*Body* imbricated with minute scales.
Corpus squamis imbricatis.	*Tail* furnished with extended bristles.

THE Linnæan genus Lepisma is far from extensive, those enumerated by Linnæus himself in the twelfth edition of the Systema Naturæ amounting to no more than three species.

Of these the chief is the *Lepisma saccharinum* *, frequently called in our own country, from its peculiar colour and tapering form, by the name of the Wood-Fish. This is an insect of great elegance. Its general length, exclusive of the caudal bristles, is about half an inch, and its colour a bright silvery grey, resembling that of pearls: this colour is owing to a covering of extremely minute oval scales, which are semitransparent, very easily detached from the animal by a slight touch: the head and thorax together form a rounded outline, the remainder of the body gradually lessening to the tail, which terminates in three long bristles, of similar appearance with the antennæ. The motions of this animal are remarkably quick, and it is often observed among various domestic articles, particularly sugar. It also occurs not unfrequently among old books and papers, which it is supposed often to injure †. It is said to be originally an American animal, and to have been imported into Europe among sugars, &c. Dr. Browne, in his History of Jamaica, represents it as "extremely destructive to books and all manner of woollen cloaths."

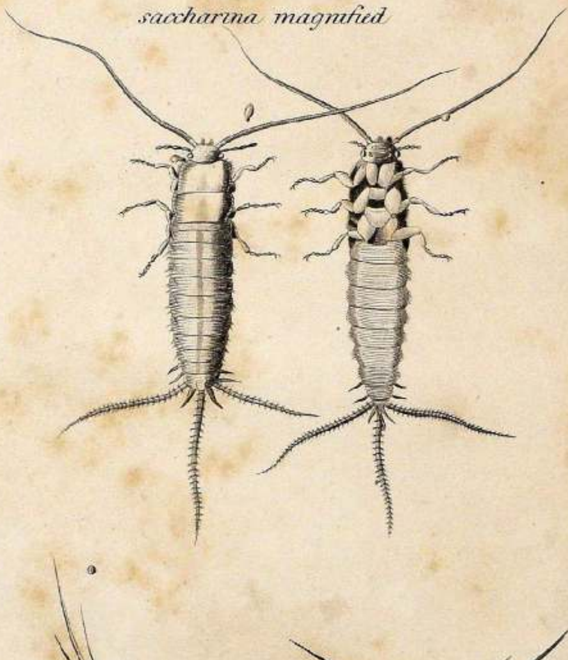
* Linnæus feminizes the word, calling it saccharina, but this is irregular.

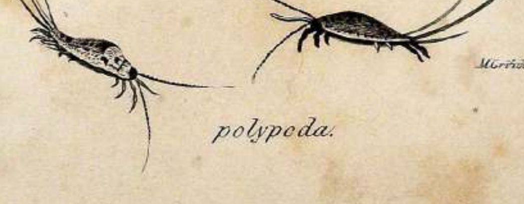
† Though the present insect may occasionally injure books and papers, yet it is certain that the principal ravages committed on those articles are owing to insects of the genera of Dermestes and Ptinus, and particularly to the Ptinus pectinicornis, which, in the course of a few days, during very hot weather, and in places where it happens to abound, will nearly destroy a book by innumerable perforations.

LEPISMA

saccharina. var Americana.

saccharina magnified





M Griffith sculp.

polypoda.

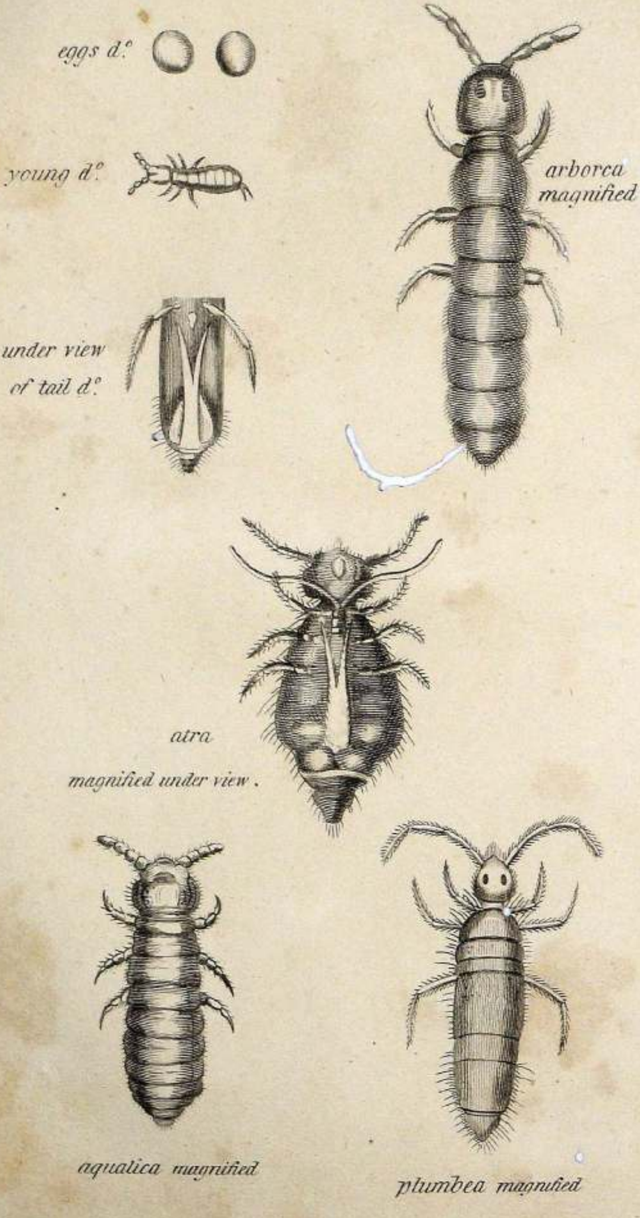
1805, Oct. 1 London, Published by G. Kearsley, Fleet Street.

The nature of this insect appears to have been singularly mistaken by that ingenious observer Mr. Henry Baker, who, in his work entitled "The Microscope made easy," calls it "the Nymph of the Clothes or Book-Moth." This error perhaps originated from the description of the animal in Hook's Micrographia, where it is entitled "the small silver-coloured Book-Worm," and, according to the loose mode of description common at the period of that work, is called "a small, white, silver-shining Worm or Moth." It is supposed by Dr. Hook to be the animal "which corrodes and eats holes through the leaves and covers." Dr. Hook thus continues. "This animal probably feeds upon the paper and covers of books, and perforates in them several small round holes, finding, perhaps, a convenient nourishment in those husks of hemp and flax which have passed through so many scourings, washings, dressings, and dryings, as the parts of old paper must necessarily have suffered; the digestive faculty, it seems, of these little creatures being able yet further to work upon those stubborn parts, and reduce them into another form; and indeed, when I consider what a heap of saw-dust or chips this little creature (which is one of the teeth of Time) conveys into its entrails, I cannot chuse but remember and admire the excellent contrivance of Nature, in placing in animals such a fire as is continually nourished and supplyed by the materials conveyed into the stomach, and fomented by the bellows of the lungs; and in so contriving the

most admirable fabrick of animals, as to make the very spending and wasting of that fire to be instrumental to the procuring and collecting more materials to augment and cherish itself, which indeed seems to be the principal end of all the contrivances observable in bruit Animals."

Lepisma polypus Lin. is of a dusky or brownish cast, and has a springing or leaping motion when disturbed. It is found about the sea coast of many northern regions, under stones, &c.

PODURA.



1805 Oct.r 1.st London Published by G. Kearsley Fleet Street.

PODURA. PODURA.

Generic Character.

Pedes sex, cursorii.	*Legs* six, formed for running.
Oculi duo, compositi ex octonis.	*Eyes* two, composed of eight.
Cauda bifurca, saltatrix, inflexa.	*Tail* forked, formed for leaping, inflected.
Antennæ setaceæ, elongatæ.	*Antennæ* setaceous, elongated.

THE Poduræ are small insects which, in general, are found in damp places, under stones, on the bark of trees, &c. When disturbed, they suddenly spring to a small distance by the help of a long, forked process, which is doubled under the abdomen, and which is suddenly thrown out during the act of leaping.

One of the most common of this genus is the *Podura aquatica* of Linnæus, measuring scarcely the twelfth part of an inch in length, and entirely of a black colour. This is a gregarious species, and is occasionally seen assembled in vast numbers, particularly near the brinks of ponds, covering the ground to the distance of several feet, and sometimes even the surface of the water itself.

On the ground its legions, on a cursory view, have the appearance of scattered grains of gunpowder; and, if closely examined, will be found in an almost continual skipping motion.

Podura fimetaria so perfectly resembles the preceding in all respects except colour, being perfectly white, that no other specific difference can be observed. It is almost equally common in damp situations with the former.

Podura atra is of a short, subglobular shape, with lengthened antennæ: its colour is a glossy black: it is found on the bark of trees, &c. &c.

Podura plumbea is of a blueish black or deep lead-colour, and is found in similar situations.

Podura arborea is of a lengthened form, and of a black colour, with the feet and caudal fork white. It is chiefly found on the bark of trees, among mosses, &c. &c.

TERMES. TERMES.

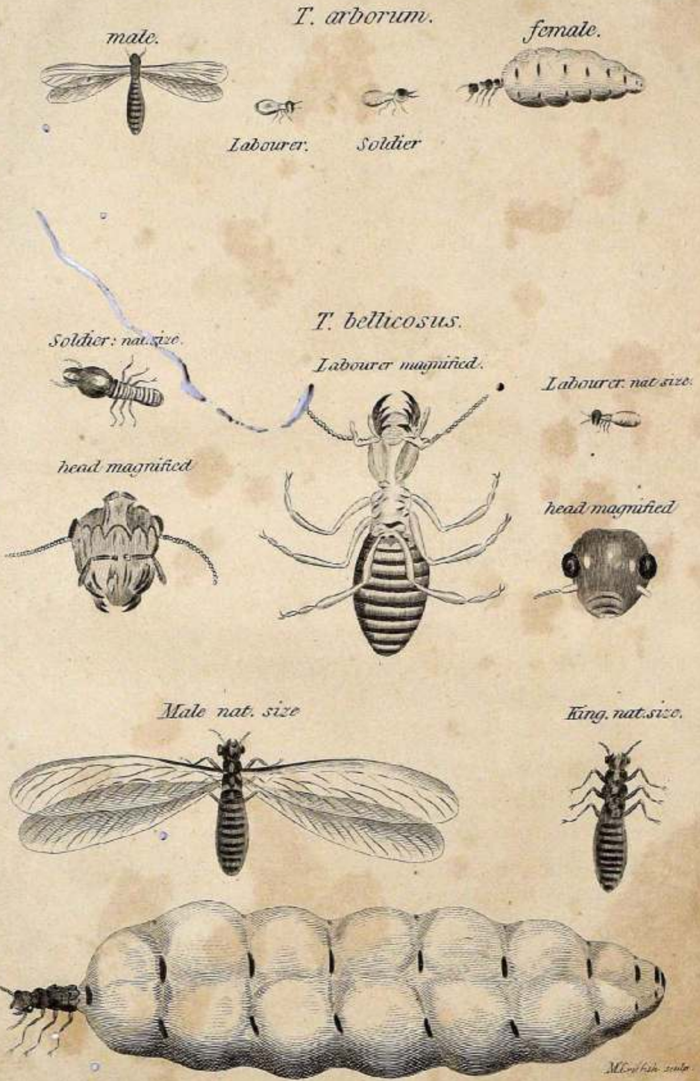
Generic Character.

Pedes sex, cursorii.	*Legs* six, formed for running.
Oculi duo.	*Eyes* two.
Antennæ setaceæ.	*Antennæ* setaceous.
Os maxillis duabus.	*Mouth* furnished with two jaws.

FROM the observations of Degeer, and the more recent ones of Mr. Smeathman, recorded in the Philosophical Transactions, it appears that the males and females of the genus Termes are, in their complete state, furnished with wings, though the labourers or neuters are destitute of those organs. The genus might therefore, in strict propriety, rather claim a place in the order Neuroptera than in that of Aptera, in which it is stationed by Linnæus.

The European species of Termes are very small, compared with those of the warmer regions of Africa and America, and, instead of assembling in multitudes, as in those climates, are usually observed single. The most common of these is the *Termes pulsatorius* of Linnæus, a diminutive insect, of a whitish colour, and which, from its

general resemblance to the insects of that genus, has by Derham and some other naturalists been distinguished by the title of *Pediculus pulsatorius*. It is very frequent, during the summer months, in houses, particularly where the wainscot is in any degree decayed, and is remarkable for causing a long-continued sound, exactly resembling the ticking of a watch. It is a very common insect in collections of dried plants, &c. which it often injures greatly. It is of so tender a frame as to be easily destroyed by the slightest pressure, and is an animal of very quick motion. When magnified, the head appears large; the eyes remarkably conspicuous, of a most beautiful gold-colour, and divided, like those of most other insects, into innumerable hexagonal convexities; the antennæ long and setaceous; the palpi or feelers two in number, of moderate length, and terminating in a large club-shaped tip; the thorax rather narrow, and the abdomen obtusely oval; the thighs or first joints of the legs thick, the remaining ones slender, and the feet furnished with very small claws: the whole animal is beset with small, scattered hairs. According to the observations of the celebrated Derham, this insect, at its first hatching from the egg, which is white, oval, and extremely small, bears a complete resemblance to a common mite, being furnished with eight legs, and beset with long hairs. After a certain time it casts its skin, and appears in the very different form above-described. Degeer observes that in some specimens he has remarked appearances si-



Pregnant Queen or female. nat. size.

1805 Oct. 1 London. Published by G. Kearsley Fleet Street.

milar to the rudiments of wings on each side the thorax, and resembling a pair of oblong scales. From my own observations I can affirm with certainty that some individuals of this species become winged when arrived at their full growth: the wings, which are four in number, being very large, of a slightly iridescent appearance, and variegated with blackish and brown clouds or spots. It is in the beginning of July that this change takes place, and at this time several may be seen with the wings half grown: in a few days they seem to obtain their full size.

Mr. Derham imagines the ticking sound which these animals produce, to be analogous to the call of birds to their mates during the breeding-season; and there seems to be no reason for calling in question the truth of this observation. I may add, that this sound, as well as that produced by the *Ptinus fatidicus*, or Death-Watch, seems to afford a convincing proof of the faculty of hearing in insects, which some naturalists have been inclined to deny.

On the bark of trees, during the decline of summer, may be sometimes observed a species of winged Termes, extremely resembling the preceding, but larger, and of a greenish brown colour, with darker variegations; and I am inclined to believe that several small species of this genus exist, which, from their general resemblance to each other, have been hitherto confounded*.

* The Hemerobins pulsatorius of Linnæus is probably one of

Of the exotic Termites the most remarkable seems to be the *Termes bellicosus*, whose history is so amply described by Mr. Smeathman in the Philosophical Transactions.

"Of a great many curious parts of the creation I met with on my travels in that almost unknown district of Africa called Guinea, the Termites, which by most travellers have been called White Ants, seemed to me on many accounts most worthy of that exact and minute attention which I have bestowed upon them.

"The amazingly great and sudden mischief they frequently do to the property of people in tropical climates, makes them well known and greatly feared by the inhabitants.

"The size and figure of their buildings have attracted the notice of many travellers, and yet the world has not hitherto been furnished with a tolerable description of them, though their contrivance and execution scarce fall short of human ingenuity and prudence; but when we come to consider the wonderful œconomy of these insects, with the good order of their subterraneous cities, they will appear foremost on the list of the wonders of the creation, as most closely imitating mankind in provident industry and regular government.

"The Termites are represented by Linnæus as the greatest plagues of both Indies, and are in-

these; being, according to his own observation, "*ita Termiti pulsatorio similis, ut demptis alis vix differat facie; an sexu solo?*"

deed every way between the Tropics so deemed, from the vast damages they cause, and the losses which are experienced in consequence of their eating and perforating wooden buildings, utensils, and furniture, with all kinds of household-stuff and merchandize, which are totally destroyed by them, if not timely prevented; for nothing less hard than metal or stone can escape their most destructive jaws.

"They have been taken notice of by various travellers in different parts of the torrid zone; and indeed where numerous, as is the case in all equinoctial countries and islands that are not fully cultivated, if a person has not been incited by curiosity to observe them, he must have been very fortunate who, after a short residence, has not been compelled to it for the safety of his property.

"These insects have generally obtained the name of Ants, it may be presumed, from the similarity in their manner of living, which is, in large communities that erect very extraordinary nests, for the most part on the furface of the ground, from whence their excursions are made through subterraneous passages or covered galleries, which they build whenever necessity obliges, or plunder induces, them to march above ground, and at a great distance from their habitations carry on a business of depredation and destruction, scarce credible but to those who have seen it. But notwithstanding they live in communities, and are like the ants omnivorous; though like

them at a certain period they are furnished with four wings, and emigrate or colonize at the same season; they are by no means the same kind of insects, nor does their form correspond with that of Ants in any one state of their existence, which, like most other insects, is changed several times.

"The Termites resemble the Ants also in their provident and diligent labour, but surpass them as well as the Bees, Wasps, Beavers, and all other animals which I have ever heard of, in the arts of building, as much as the Europeans excel the least cultivated savages. It is more than probable they excel them as much in sagacity and the arts of government; it is certain they shew more substantial instances of their ingenuity and industry than any other animals; and do in fact lay up vast magazines of provisions and other stores; a degree of prudence which has of late years been denied, perhaps without reason, to the Ants.

"Their communities consist of one male and one female (who are generally the common parents of the whole, or greater part, of the rest), and of three orders of insects, apparently of very different species, but really the same, which together compose great commonwealths, or rather monarchies, if I may be allowed the term.

"The great Linnæus, having seen or heard of but two of these orders, has classed the genus erroneously; for he has placed it among the *Aptera*, or insects without wings; whereas the chief order, that is to say, the insect in its perfect state, having

four wings without any sting, it belongs to the *Neuroptera;* in which class it will constitute a new genus of many species.

"The different species of this genus resemble each other in form, in their manner of living, and in their good and bad qualities; but differ as much as birds in the manner of building their habitations or nests, and in the choice of the materials of which they compose them.

"There are some species which build upon the surface of the ground, or part above and part beneath, and one or two species, perhaps more, that build on the stems or branches of trees, sometimes aloft at a vast height.

"Of every species there are three orders; first, the working insects, which, for brevity, I shall generally call *labourers;* next the fighting ones, or *soldiers,* which do no kind of labour; and, last of all, the winged ones, or *perfect insects,* which are male and female, and capable of propagation. These might very appositely be called the *nobility* or *gentry,* for they neither labour, or toil, or fight, being quite incapable of either, and almost of self-defence. These only are capable of being elected kings or queens; and nature has so ordered it, that they emigrate within a few weeks after they are elevated to this state, and either establish new kingdoms, or perish within a day or two.

"The *Termes bellicosus* being the largest species is most remarkable and best known on the coast of Africa. It erects immense buildings of well-tempered clay or earth, which are contrived

and finished with such art and ingenuity, that we are at a loss to say, whether they are most to be admired on that account, or for their enormous magnitude and solidity. It is from the two lower orders of this, or a similar species, that Linnæus seems to have taken his description of the *Termes Fatalis;* and most of the accounts brought home from Africa or Asia of the white Ants are also taken from a species that are so much alike in external habit and size, and build so much in their manner, that one may almost venture to pronounce them mere variations of the same species.

"My general account of the Termites is taken from observations made on the *Termes bellicosus*, to which I was induced by the greater facility and certainty with which they could be made.

"The nests of this species are so numerous all over the island of Bananas, and the adjacent continent of Africa, that it is scarce possible to stand upon any open place, such as a rice plantation, or other clear spot, where one of these buildings is not to be seen within fifty paces, and frequently two or three are to be seen almost close to each other. In some parts near Senegal, as mentioned by Mons. Adanson, their number, magnitude, and closeness of situation, make them appear like the villages of the natives.

"These buildings are usually termed hills, by natives as well as strangers, from their outward appearance, which is that of little hills more or less conical, generally pretty much in the form of sugar loaves, and about ten or twelve feet in per-

pendicular height above the common surface of the ground.

"These hills continue quite bare until they are six or eight feet high; but in time the dead barren clay, of which they are composed, becomes fertilized by the genial power of the elements in these prolific climates, and the addition of vegetable salts and other matters brought by the wind; and in the second or third year, the hillock, if not over-shaded by trees, becomes, like the rest of the earth, almost covered with grass and other plants; and in the dry season, when the herbage is burnt up by the rays of the sun, it is not much unlike a very large hay-cock.

"Every one of these buildings consists of two distinct parts, the exterior and the interior.

"The exterior is one large shell in the manner of a dome, large and strong enough to inclose and shelter the interior from the vicissitudes of the weather, and the inhabitants from the attacks of natural or accidental enemies. It is always, therefore, much stronger than the interior building, which is the habitable part divided with a wonderful kind of regularity and contrivance into an amazing number of apartments for the residence of the king and queen, and the nursing of their numerous progeny; or for magazines, which are always found well filled with stores and provisions.

"These hills make their first appearance above ground by a little turret or two in the shape of sugar loaves, which are run a foot high or more. Soon after, at some little distance, while the former

are increasing in height and size, they raise others, and so go on increasing the number and widening them at the base, till their works below are covered with these turrets, which they always raise the highest and largest in the middle, and by filling up the intervals, between each turret, collect them as it were into one dome.

"They are not very curious or exact about these turrets, except in making them very solid and strong, and when by the junction of them the dome is completed, for which purpose the turrets answer as scaffolds, they take away the middle ones entirely, except the tops (which joined together make the crown of the cupola) and apply the clay to the building of the works within, or to erecting fresh turrets for the purpose of raising the hillock still higher; so that no doubt some part of the clay is used several times, like the boards and posts of a mason's scaffold.

"The outward shell or dome is not only of use to protect and support the interior buildings from external violence and the heavy rains; but to collect and preserve a regular degree of genial warmth and moisture which seems very necessary for hatching the eggs and cherishing the young ones.

"The royal chamber, which I call so on account of its being adapted for, and occupied by, the king and queen, appears to be in the opinion of this little people of the most consequence, being always situated as near the center of the interior building as possible, and generally about

the height of the common surface of the ground, at a pace or two from the hillock. It is always nearly in the shape of half an egg or an obtuse oval within, and may be supposed to represent a long oven.

"In the infant state of the colony, it is not above an inch or thereabout in length; but in time will be increased to six or eight inches or more in the clear, being always in proportion to the size of the queen, who, increasing in bulk as in age, at length requires a chamber of such dimensions.

"Its floor is perfectly horizontal; and in large hillocks, sometimes an inch thick and upward of solid clay. The roof also, which is one solid and well-turned oval arch, is generally of about the same solidity, but in some places it is not a quarter of an inch thick, this is on the sides where it joins the floor, and where the doors or entrances are made level therewith at pretty equal distances from each other.

"These entrances will not admit any animal larger than the soldiers or labourers, so that the king, and the queen (who is, at full size, a thousand times the weight of a king) can never possibly go out.

"The royal chamber, if in a large hillock, is surrounded by an innumerable quantity of others of different sizes, shapes, and dimensions; but all of them arched in one way or another, sometimes circular, and sometimes elliptical or oval.

"These either open into each other or commu-

nicate by passages as wide, and being always empty are evidently made for the soldiers and attendants, of whom it will soon appear great numbers are necessary, and of course always in waiting.

"These apartments are joined by the magazines and nurseries. The former are chambers of clay, and are always well filled with provisions, which to the naked eye seem to consist of the raspings of wood and plants which the Termites destroy, but are found in the microscope to be principally the gums or inspissated juices of plants. These are thrown together in little masses, some of which are finer than others, and resemble the sugar about preserved fruits, others are like tears of gum, one quite transparent, another like amber, a third brown, and a fourth quite opaque, as we see often in parcels of ordinary gums.

"These magazines are intermixed with the nurseries, which are buildings totally different from the rest of the apartments: for these are composed entirely of wooden materials, seemingly joined together with gums. I call them the nurseries because they are invariably occupied by the eggs, and young ones, which appear at first in the shape of labourers, but white as snow. These buildings are exceeding compact, and divided into many very small irregular-shaped chambers, not one of which is to be found of half an inch in width. They are placed all round the royal apartments, and as near as possible to them.

"When the nest is in the infant state, the

nurseries are close to the royal chamber; but as in process of time the queen enlarges, it is necessary to enlarge the chamber for her accommodation; and as she then lays a greater number of eggs, and requires a greater number of attendants, so it is necessary to enlarge and encrease the number of the adjacent apartments; for which purpose the small nurseries which are first built are taken to pieces, rebuilt a little farther off a size bigger, and the number of them encreased at the same time.

"Thus they continually enlarge their apartments, pull down, repair, or rebuild, according to their wants, with a degree of sagacity, regularity, and foresight, not even imitated by any other kind of animals or insects that I have yet heard of.

"There is one remarkable circumstance attending the nurseries, which I must not at this time omit. They are always found slightly overgrown with and plentifully sprinkled with small white globules about the size of a small pin's head. These at first I took to be the eggs; but, on bringing them to the microscope, they evidently appeared to be a species of mushroom, in shape like our eatable mushroom in the young state in which it is pickled. They appear, when whole, white like snow a little thawed and then frozen again, and when bruised seem composed of an infinite number of pellucid particles, approaching to oval forms and difficult to separate; the mouldi-

ness seems likewise to be the same kind of substance.

"The nurseries are inclosed in chambers of clay, like those which contain the provisions, but much larger. In the early state of the nest they are not bigger than an hazel-nut, but in great hills are often as large as a child's head of a year old.

"The disposition of the interior parts of these hills is pretty much alike, except when some insurmountable obstacle prevents; for instance, when the king and queen have been first lodged near the foot of a rock or of a tree, they are certainly built out of the usual form, otherwise pretty nearly according to the following plan.

"The royal chamber is situated at about a level with the surface of the ground, at an equal distance from all the sides of the building, and directly under the apex of the hill.

"It is on all sides, both above and below, surrounded by what I should call the royal apartments, which have only labourers and soldiers in them, and can be intended for no other purpose than for these to wait in, either to guard or serve their common father and mother, on whose safety depends the happiness, and, according to the negroes, even the existence of the whole community.

"These apartments compose an intricate labyrinth, which extends a foot or more in diameter from the royal chamber on every side. Here the nurseries and magazines of provisions begin, and,

being separated by small empty chambers and galleries, which go round them or communicate from one to the other, are continued on all sides to the outward shell, and reach up within it two-thirds or three-fourths of its height, leaving an open area in the middle under the dome, which very much resembles the nave of an old cathedral: this is surrounded by three or four very large Gothic-shaped arches, which are sometimes two or three feet high next the front of the area, but diminish very rapidly as they recede from thence like the arches of aisles in perspectives, and are soon lost among the innumerable chambers and nurseries behind them.

" All these chambers, and the passages leading to and from them, being arched, they help to support one another; and while the interior large arches prevent them falling into the center, and keep the area open, the exterior building supports them on the outside.

" There are, comparatively speaking, few openings into the great area, and they for the most part seem intended only to admit that genial warmth into the nurseries which the dome collects.

" The interior building or assemblage of nurseries, chambers, &c. has a flattish top or roof without any perforation, which would keep the apartments below dry, in case through accident the dome should receive any injury and let in water; and it is never exactly flat and uniform, because they are always adding to it by building more chambers and nurseries: so that the divi-

sions or columns between the future arched apartments resemble the pinnacles upon the fronts of some old buildings, and demand particular notice as affording one proof that for the most part the insects project their arches, and do not make them, as I imagined for a long time, by excavation.

"The area has also a flattish floor, which lies over the royal chamber, but sometimes a good height above it, having nurseries and magazines between. It is likewise water-proof, and contrived, as far as I could guess, to let the water off, if it should get in, and run over by some short way into the subterraneous passages which run under the lowest apartments in the hill in various directions, and are of an astonishing size, being wider than the bore of a great cannon. I have a memorandum of one I measured, perfectly cylindrical, and thirteen inches in diameter.

"These subterraneous passages or galleries are lined very thick with the same kind of clay of which the hill is composed, and ascend the inside of the outward shell in a spiral manner, and winding round the whole building up to the top intersect each other at different heights, opening either immediately into the dome in various places, and into the interior building, the new turrets, &c. or communicating thereto by other galleries of different bores or diameters, either circular or oval.

"From every part of these large galleries are various small pipes or galleries leading to different parts of the building. Under ground there are a

great many which lead downward by sloping descents three and four feet perpendicular among the gravel, from whence the labouring Termites cull the finer parts, which, being worked up in their mouths to the consistence of mortar, becomes that solid clay or stone of which their hills and all their buildings, except their nurseries, are composed.

"Other galleries again ascend and lead out horizontally on every side, and are carried under ground near to the surface a vast distance: for if you destroy all the nests within one hundred yards of your house, the inhabitants of those which are left unmolested farther off will nevertheless carry on their subterraneous galleries, and invade the goods and merchandizes contained in it by sap and mine, and do great mischief, if you are not very circumspect.

"But to return to the cities from whence these extraordinary expeditions and operations originate, it seems there is a degree of necessity for the galleries under the hills being thus large, being the great thoroughfares for all the labourers and soldiers going forth or returning upon any business whatever, whether fetching clay, wood, water, or provisions; and they are certainly well calculated for the purposes to which they are applied, by the spiral slope which is given them; for if they were perpendicular the labourers would not be able to carry on their building with so much facility, as they ascend a perpendicular with

great difficulty, and the soldiers can scarce do it at all. It is on this account that sometimes a road like a ledge is made on the perpendicular side of any part of the building within their hill, which is flat on the upper surface, and half an inch wide, and ascends gradually like a stair-case, or like those roads which are cut on the sides of hills and mountains, that would otherwise be inaccessible: by which, and similar contrivances, they travel with great facility to every interior part.

"This too is probably the cause of their building a kind of bridge of one vast arch, which answers the purpose of a flight of stairs from the floor of the area to some opening on the side of one of the columns which support the great arches, which must shorten the distance exceedingly to those labourers who have the eggs to carry from the royal chamber to some of the upper nurseries, which in some hills would be four or five feet in the straightest line, and much more if carried through all the winding passages which lead through the inner chambers and apartments.

"I have a memorandum of one of these bridges, half an inch broad, a quarter of an inch thick, and ten inches long, making the side of an elliptic arch of proportionable size; so that it is wonderful it did not fall over or break by its own weight before they got it joined to the side of the column above. It was strengthened by a small arch at the bottom, and had a hollow or groove all the length of the upper surface, either made pur-

posely for the inhabitants to travel over with more safety, or else, which is not improbable, worn so by frequent treading.

"I have observed before, that there are of every species of Termites three orders; of these orders the working insects or labourers are always the most numerous; in the *Termes bellicosus* there seems to be at the least one hundred labourers to one of the fighting insects or soldiers. They are in this state about one-fourth of an inch long, and twenty-five of them weigh about a grain; so that they are not so large as some of our ants. From their external habit and fondness for wood, they have been very expressively called Wood Lice by some people, and the whole genus has been known by that name, particularly among the French. They resemble them, it is true, very much at a distance, but they run as fast or faster than any other insects of their size, and are incessantly bustling about their affairs.

"The second order, or soldiers, have a very different form from the labourers, and have been by some authors supposed to be the males, and the former neuters; but they are, in fact, the same insects as the foregoing, only they have undergone a change of form, and approached one degree nearer to the perfect state. They are now much larger, being half an inch long, and equal in bulk to fifteen of the labourers.

"There is now likewise a most remarkable circumstance in the form of the head and mouth; for in the former state the mouth is evidently cal-

culated for gnawing and holding bodies; but in this state, the jaws being shaped just like two very sharp awls a little jagged, they are incapable of any thing but piercing or wounding, for which purposes they are very effectual, being as hard as a crab's claw, and placed in a strong horny head, which is of a nut-brown colour, and larger than all the rest of the body together, which seems to labour under great difficulty in carrying it: on which account perhaps the animal is incapable of climbing up perpendicular surfaces.

"The third order, or the insect in its perfect state, varies its form still more than ever. The head, thorax, and abdomen, differ almost entirely from the same parts in the labourers and soldiers; and, besides this, the animal is now furnished with four fine large brownish, transparent, wings, with which it is at the time of emigration to wing its way in search of a new settlement. In short, it differs so much from its form and appearance in the other two states, that it has never been supposed to be the same animal, but by those who have seen it in the same nest; and some of these have distrusted the evidence of their senses. It was so long before I met with them in the nests myself, that I doubted the information which was given me by the natives, that they belonged to the same family. Indeed we may open twenty nests without finding one winged one, for those are to be found only just before the commencement of the rainy season, when they undergo the last change, which is preparative to their colonization.

Add to this, they sometimes abandon an outward part of their building, the community being diminished by some accident to me unknown. Sometimes too different species of the real Ant (Formica) possess themselves by force of a lodgement, and so are frequently dislodged from the same nest, and taken for the same kind of insects. This I know is often the case with the nests of the smaller species, which are frequently totally abandoned by the Termites, and completely inhabited by different species of Ants, Cockroaches, Scolopendræ, Scorpions, and other vermin, fond of obscure retreats, that occupy different parts of their roomy buildings.

"In the winged state they have also much altered their size as well as form. Their bodies now measure between six and seven tenths of an inch in length, and their wings above two inches and a half from tip to tip, and they are equal in bulk to about thirty labourers, or two soldiers. They are now also furnished with two large eyes placed on each side of the head, and very conspicuous; if they have any before, they are not easily to be distinguished. Probably in the two first states, their eyes, if they have any, may be small like those of moles; for as they live like these animals always under ground, they have as little occasion for these organs, and it is not to be wondered at that we do not discover them; but the case is much altered when they arrive at the winged state in which they are to roam, though but for a few hours, through the wide air, and ex-

plore new and distant regions. In this form the animal comes abroad during or soon after the first tornado, which at the latter end of the dry season proclaims the approach of the ensuing rains, and seldom waits for a second or third shower, if the first, as is generally the case, happens in the night, and brings much wet after it.

"The quantities that are to be found the next morning all over the surface of the earth, but particularly on the waters, is astonishing; for their wings are only calculated to carry them a few hours, and after the rising of the sun not one in a thousand is to be found with four wings, unless the morning continues rainy, when here and there a solitary being is seen winging its way from one place to another, as if solicitous only to avoid its numerous enemies, particularly various species of Ants which are hunting on every spray, on every leaf, and in every possible place, for this unhappy race, of which probably not a pair in many millions get into a place of safety, fulfil the first law of nature, and lay the foundation of a new community.

"Not only all kinds of ants, birds, and carnivorous reptiles, as well as insects, are upon the hunt for them, but the inhabitants of many countries, and particularly of that part of Africa where I was, eat them.

"On the following morning, however, as I have observed, they are to be seen running upon the ground in chace of each other; sometimes with one or two wings still hanging to their bo-

dies, which are not only useless, but seem rather cumbersome.

"The greater part have no wings, but they run exceeding fast, the males after the females; I have sometimes remarked two males after one female, contending with great eagerness who should win the prize, regardless of the innumerable dangers that surrounded them.

"They are now become from one of the most active, industrious, and rapacious, one of the most fierce and implacable little animals in the world, the most innocent, helpless, and cowardly; never making the least resistance to the smallest Ant. The Ants are to be seen on every side in infinite numbers, of various species and sizes, dragging these annual victims of the laws of nature to their different nests. It is wonderful that a pair should ever escape so many dangers, and get into a place of security. Some, however, are so fortunate; and being found by some of the labouring insects that are continually running about the surface of the ground under their covered galleries, which I shall shortly describe, are elected kings and queens of new states; all those who are not so elected and preserved certainly perish, and most probably in the course of the following day. The manner in which these labourers protect the happy pair from their innumerable enemies, not only on the day of the massacre of almost all their race, but for a long time after, will I hope justify me in the use of the term Election. The little industrious creatures immediately enclose

them in a small chamber of clay suitable to their size, into which at first they leave but one small entrance, large enough for themselves and the soldiers to go in and out, but much too little for either of the royal pair to make use of; and when necessity obliges them to make more entrances, they are never larger; so that, of course, the voluntary subjects charge themselves with the task of providing for the offspring of their sovereigns, as well as to work and to fight for them until they shall have raised a progeny capable at least of dividing the task with them.

"About this time a most extraordinary change begins to take place in the queen, to which I know nothing similar, except in the *Pulex penetrans* of Linnæus, the Jigger of the West Indies, and in the different species of Coccus, Cochineal. The abdomen of this female begins gradually to extend and enlarge to such an enormous size, that an old queen will have it increased so as to be fifteen hundred or two thousand times the bulk of the rest of her body, and twenty or thirty thousand times the bulk of a labourer, as I have found by carefully weighing and computing the different states. The skin between the segments of the abdomen extends in every direction; and at last the segments are removed to half an inch distance from each other, though at first the length of the whole abdomen is not half an inch. They preserve their dark brown colour, and the upper part of the abdomen is marked with a regular series of brown bars from the thorax to the posterior part

of the abdomen, while the intervals between them are covered with a thin, delicate, transparent skin, and appear of a fine cream colour, a little shaded by the dark colour of the intestines and watery fluid seen here and there beneath. I conjecture the animal is upwards of two years old when the abdomen is increased to three inches in length: I have sometimes found them of near twice that size. The abdomen is now of an irregular oblong shape, being contracted by the muscles of every segment, and is become one vast matrix full of eggs, which make long circumvolutions through an innumerable quantity of very minute vessels that circulate round the inside in a serpentine manner, which would exercise the ingenuity of a skilful anatomist to dissect and develope. This singular matrix is not more remarkable for its amazing extension and size than for its peristaltic motion, which resembles the undulating of waves, and continues incessantly without any apparent effort of the animal; so that one part or other alternately is rising and sinking in perpetual succession, and the matrix seems never at rest, but is always protruding eggs to the amount (as I have frequently counted in old queens) of sixty in a minute, or eighty thousand and upward in one day of twenty-four hours.

"These eggs are instantly taken from her body by her attendants (of whom there always are, in the royal chamber and the galleries adjacent, a sufficient number in waiting) and carried to the nurseries, which in a great nest may some of them

be four or five feet distant in a straight line, and consequently much farther by their winding galleries. Here, after they are hatched, the young are attended and provided with every thing necessary until they are able to shift for themselves, and take their share of the labours of the community. The foregoing, I flatter myself, is an accurate description and account of the *Termes bellicosus* or species that builds the large nests in its different states.

"The Termites, except their heads, are exceeding soft, and covered with a very thin and delicate skin; being blind, they are no match on open ground for the ants, who can see, and are all of them covered with a strong horny shell not easily pierced, and are of dispositions bold, active, and rapacious. Whenever the Termites are dislodged from their covered ways, the various species of the former, who probably are as numerous above ground as the latter are in their subterraneous passages, instantly seize and drag them away to their nests, to feed the young brood. The Termites are therefore exceeding solicitous about the preserving their covered ways in good repair; and if you demolish one of them, for a few inches in length, it is wonderful how soon they rebuild it. At first in their hurry they get into the open part an inch or two, but stop so suddenly that it is very apparent they are surprized: for though some run straight on, and get under the arch as speedily as possible in the former part, most of them run as fast back, and very few will venture

through that part of the track which is left uncovered. In a few minutes you will perceive them rebuilding the arch, and by the next morning they will have restored their gallery for three or four yards in length, if so much has been ruined; and upon opening it again will be found as numerous as ever, under it, passing both ways. If you continue to destroy it several times, they will at length seem to give up the point, and build another in a different direction; but, if the old one led to some favourite plunder, in a few days will rebuild it again; and, unless you destroy their nest, never totally abandon their gallery.

"The *Termites arborum*, those which build in trees, frequently establish their nests within the roofs and other parts of houses, to which they do considerable damage, if not timely extirpated.

"The large species are, however, not only much more destructive, but more difficult to be guarded against, since they make their approaches chiefly under ground, descending below the foundations of houses and stores at several feet from the surface, and rising again either in the floors, or entering at the bottoms of the posts, of which the sides of the buildings are composed, bore quite through them, following the course of the fibres to the top, or making lateral perforations and cavities here and there as they proceed.

"While some are employed in gutting the posts, others ascend from them, entering a rafter or some other part of the roof. If they once find the thatch, which seems to be a favourite food,

they soon bring up wet clay, and build their pipes or galleries through the roof in various directions, as long as it will support them; sometimes eating the palm-tree leaves and branches of which it is composed, and, perhaps (for variety seems very pleasing to them) the rattan or other running plant which is used as a cord to tye the various parts of the roof together, and that to the posts which support it: thus, with the assistance of the rats, who during the rainy season are apt to shelter themselves there, and to burrow through it, they very soon ruin the house by weakening the fastenings and exposing it to the wet. In the mean time the posts will be perforated in every direction as full of holes as that timber in the bottoms of ships which has been bored by the worms; the fibres and knotty parts, which are the hardest, being left to the last.

"They sometimes, in carrying on this business, find, I will not pretend to say how, that the post has some weight to support, and then if it is a convenient track to the roof, or is itself a kind of wood agreeable to them, they bring their mortar, and fill all or most of the cavities, leaving the necessary roads through it, and as fast as they take away the wood replace the vacancy with that material; which being worked together by them closer and more compactly than human strength or art could ram it, when the house is pulled to pieces, in order to examine if any of the posts are fit to be used again, those of the softer kinds are often found reduced almost to a shell, and all

or a greater part transformed from wood to clay as solid and as hard as many kinds of free-stone used for building in England. It is much the same when the *Termites bellicosi* get into a chest or trunk containing cloaths and other things; if the weight above is great, or they are afraid of Ants or other enemies, and have time, they carry their pipes through, and replace a great part with clay, running their galleries in various directions. The tree Termites, indeed, when they get within a box, often make a nest there, and being once in possession destroy it at their leisure. They did so to the pyramidal box which contained my compound microscope. It was of mahogany, and I had left it in the store of Governor Campbell of Tobago, for a few months, while I made the tour of the Leeward Islands. On my return I found these insects had done much mischief in the store, and, among other things, had taken possession of the microscope, and eaten every thing about it except the glass or metal, and the board on which the pedestal is fixed, with the drawers under it, and the things inclosed. The cells were built all round the pedestal and the tube, and attached to it on every side. All the glasses which were covered with the wooden substance of their nests retained a cloud of a gummy nature upon them that was not easily got off, and the lacquer or burnish with which the brass work was covered was totally spoiled. Another party had taken a liking to the staves of a Madeira cask, and had let out almost a pipe of fine old wine. If the

large species of Africa (the *Termites bellicosi*) had been so long in the uninterrupted possession of such a store, they would not have left twenty pounds weight of wood remaining of the whole building, and all that it contained.

"These insects are not less expeditious in destroying the shelves, wainscotting, and other fixtures of an house, than the house itself. They are for ever piercing and boring in all directions, and sometimes go out of the broadside of one post into that of another joining to it; but they prefer and always destroy the softer substances the first, and are particularly fond of pine and fir-boards, which they excavate and carry away with wonderful dispatch and astonishing cunning: for, except a shelf has something standing upon it, as a book, or any thing else which may tempt them, they will not perforate the surface, but artfully preserve it quite whole, and eat away all the inside, except a few fibres which barely keep the two sides connected together, so that a piece of an inch-board which appears solid to the eye will not weigh much more than two sheets of paste-board of equal dimensions, after these animals have been a little while in possession of it. In short, the Termites are so insidious in their attacks, that we cannot be too much on our guard against them: they will sometimes begin and raise their works, especially in new houses, through the floor. If you destroy the work so begun, and make a fire upon the spot, the next night they will attempt to rise through another part; and, if they happen to emerge

under a chest or trunk early in the night, will pierce the bottom, and destroy or spoil every thing in it before the morning. On these accounts we are careful to set all our chests and boxes upon stones or bricks, so as to leave the bottoms of such furniture some inches above the ground; which not only prevents these insects finding them out so readily, but preserves the bottoms from a corrosive damp which would strike from the earth through, and rot every thing therein: a vast deal of vermin also would harbour under, such as Cock-roaches, Centipedes, Millepedes, Scorpions, Ants, and various other noisome insects.

"When the Termites attack trees and branches in the open air, they sometimes vary their manner of doing it. If a stake in a hedge has not taken root and vegetated, it becomes their business to destroy it. If it has a good sound bark round it, they will enter at the bottom, and eat all but the bark, which will remain, and exhibit the appearance of a solid stick (which some vagrant colony of Ants or other insects often shelter in till the winds disperse it); but if they cannot trust the bark, they cover the whole stick with their mortar, and it then looks as if it had been dipped into thick mud that had been dried on. Under this covering they work, leaving no more of the stick and bark than is barely sufficient to support it, and frequently not the smallest particle, so that upon a very small tap with your walking-stick, the whole stake, though apparently as thick as

your arm, and five or six feet long, loses its form, and disappearing like a shadow falls in small fragments at your feet. They generally enter the body of a large tree which has fallen through age or been thrown down by violence, on the side next the ground, and eat away at their leisure within the bark, without giving themselves the trouble either to cover it on the outside, or to replace the wood which they have removed from within, being somehow sensible that there is no necessity for it. These excavated trees have deceived me two or three times in running: for, attempting to step two or three feet high, I might as well have attempted to step upon a cloud, and have come down with such unexpected violence, that, besides shaking my teeth and bones almost to dislocation, I have been precipitated, head foremost, among the neighbouring trees and bushes. Sometimes, though seldom, the animals are known to attack living trees; but not, I apprehend, before symptoms of mortification have appeared at the roots, since it is evident, as is before observed, that these insects are intended in the order of nature to hasten the dissolution of such trees and vegetables as have arrived at their greatest maturity and perfection, and which would, by a tedious decay, serve only to encumber the face of the earth. This purpose they answer so effectually, that nothing perishable escapes them, and it is almost impossible to leave any thing penetrable upon the ground a long time in safety; for the odds are, that, put it where you will abroad, they will find it out before the follow-

ing morning, and its destruction follows very soon of course. In consequence of this disposition, the woods never remain long encumbered with the fallen trunks of trees or their branches; and thus it is, as I have before observed, the total destruction of deserted towns is so effectually completed, that in two or three years a thick wood fills the space; and, unless iron-wood posts have been made use of, not the least vestige of an house is to be discovered.

"The first object of admiration which strikes one upon opening their hills is the behaviour of the soldiers. If you make a breach in a slight part of the building, and do it quickly with a strong hoe or pick-axe, in the space of a few seconds a soldier will run out, and walk about the breach, as if to see whether the enemy is gone, or to examine what is the cause of the attack. He will sometimes go again, as if to give the alarm: but most frequently, in a short time, is followed by two or three others, who run as fast as they can, straggling after one another, and are soon followed by a large body who rush out as fast as the breach will permit them, and so they proceed, the number increasing, as long as any one continues battering their building. It is not easy to describe the rage and fury they shew. In their hurry they frequently miss their hold, and tumble down the sides of the hill, but recover themselves as quickly as possible; and, being blind, bite every thing they run against, and thus make a crackling noise, while some of them beat repeatedly with their

forceps upon the building, and make a small vibrating noise, something shriller and quicker than the ticking of a watch: I could distinguish this noise at three or four feet distance, and it continued for a minute at a time, with short intervals. While the attack proceeds they are in the most violent bustle and agitation. If they get hold of any one, they will in an instant let out blood enough to weigh against their whole body; and if it is the leg they wound, you will see the stain upon the stocking extend an inch in width. They make their hooked jaws meet at the first stroke, and never quit their hold, but suffer themselves to be pulled away leg by leg, and piece after piece, without the least attempt to escape. On the other hand, keep out of their way, and give them no interruption, and they will in less than half an hour retire into the nest, as if they supposed the wonderful monster that damaged their castle to be gone beyond their reach. Before they are all got in you will see the labourers in motion, and hastening in various directions toward the breach: every one with a burthen of mortar in his mouth ready tempered. This they stick upon the breach as fast as they come up, and do it with so much dispatch and facility, that although there are thousands, and I may say millions, of them, they never stop or embarrass one another; and you are most agreeably deceived when, after an apparent scene of hurry and confusion, a regular wall arises, gradually filling up the chasm. While they are thus employed,

almost all the soldiers are retired quite out of sight, except here and there one, who saunters about among six hundred or a thousand of the labourers, but never touches the mortar either to lift or carry it; one, in particular, places himself close to the wall they are building. This soldier will turn himself leisurely on all sides, and every now and then, at intervals of a minute or two, lift up his head, and with his forceps beat upon the building, and make the vibrating noise before mentioned; on which immediately a loud hiss, which appears to come from all the labourers, issues from within side the dome and all the subterraneous caverns and passages: that it does come from the labourers is very evident, for you will see them all hasten at every such signal, redouble their pace, and work as fast again.

"As the most interesting experiments become dull by repetition or continuance, so the uniformity with which this business is carried on, though so very wonderful, at last satiates the mind. A renewal of the attack, however, instantly changes the scene, and gratifies our curiosity still more. At every stroke we hear a loud hiss; and on the first the labourers run into the many pipes and galleries with which the building is perforated, which they do so quickly that they seem to vanish, for in a few seconds all are gone, and the soldiers rush out as numerous and as vindictive as before. On finding no enemy they return again leisurely into the hill, and very soon after the labourers appear loaded as at first, as active and as sedulous,

with soldiers here and there among them, who act just in the same manner, one or other of them giving the signal to hasten the business. Thus the pleasure of seeing them come out to fight or to work alternately may be obtained as often as curiosity excites or time permits: and it will certainly be found, that the one order never attempts to fight, or the other to work, let the emergency be ever so great.

"We meet vast obstacles in examining the interior parts of these tumuli. In the first place, the works, for instance, the apartments which surround the royal chamber and the nurseries, and indeed the whole internal fabric, are moist, and consequently the clay is very brittle: they have also so close a connexion, that they can only be seen as it were by piece-meal; for having a kind of geometrical dependance or abutment against each other, the breaking of one arch pulls down two or three. To these obstacles must be added the obstinacy of the soldiers, who fight to the very last, disputing every inch of ground so well as often to drive away the negroes who are without shoes, and make white people bleed plentifully through their stockings. Neither can we let a building stand so as to get a view of the interior parts without interruption, for while the soldiers are defending the out-works, the labourers keep barricadoing all the way against us, stopping up the different galleries and passages which lead to the various apartments, particularly the royal chamber, all the entrances to which they fill up so art-

fully as not to let it be distinguishable while it remains moist; and externally it has no other appearance than that of a shapeless lump of clay. It is, however, easily found from its situation with respect to the other parts of the building, and by the crouds of labourers and soldiers which surround it, who shew their loyalty and fidelity by dying under its walls. The royal chamber in a large nest is capacious enough to hold many hundreds of the attendants, besides the royal pair, and you always find it as full of them as it can hold. These faithful subjects never abandon their charge even in the last distress; for whenever I took out the royal chamber, and, as I often did, preserved it for some time in a large glass bowl, all the attendants continued running in one direction round the king and queen with the utmost solicitude, some of them stopping on every circuit at the head of the latter, as if to give her something. When they came to the extremity of the abdomen, they took the eggs from her, and carried them away, and piled them carefully together in some part of the chamber, or in the bowl under, or behind any pieces of broken clay which lay most convenient for the purpose.

"Some of these little unhappy creatures would ramble from the chamber, as if to explore the cause of such a horrid ruin and catastrophe to their immense building, as it must appear to them; and, after fruitless endeavours to get over the side of the bowl, return and mix with the croud that continue running round their common parents to the last. Others, placing themselves

along her side, get hold of the queen's vast matrix with their jaws, and pull with all their strength so as visibly to lift up the part which they fix at; but, as I never saw any effect from these attempts, I never could determine whether this pulling was with an intention to remove her body, or to stimulate her to move herself, or for any other purpose; but, after many ineffectual tugs, they would desist and join in the croud running round, or assist some of those who are cutting off clay from the external parts of the chamber or some of the fragments and moistening it with the juices of their bodies, to begin to work a thin arched shell over the body of the queen, as if to exclude the air, or to hide her from the observation of some enemy. These, if not interrupted, before the next morning, completely cover her, leaving room enough within for great numbers to run about her.

"I do not mention the king in this case, because he is very small in proportion to the queen, not being bigger than thirty of the labourers, so that he generally conceals himself under one side of the abdomen, except when he goes up to the queen's head, which he does now and then, but not so frequently as the rest.

"If in your attack on the hill you stop short of the royal chamber, and cut down about half of the building, and leave open some thousands of galleries and chambers, they will all be shut up with thin sheets of clay before the next morning. If even the whole is pulled down, and the different buildings are thrown in a confused heap of ruins,

provided the king and queen are not destroyed or taken away, every interstice between the ruins, at which either cold or wet can possibly enter, will be so covered as to exclude both, and, if the animals are left undisturbed, in about a year they will raise the building to near its pristine size and grandeur."

PEDICULUS. LOUSE.

Generic Character.

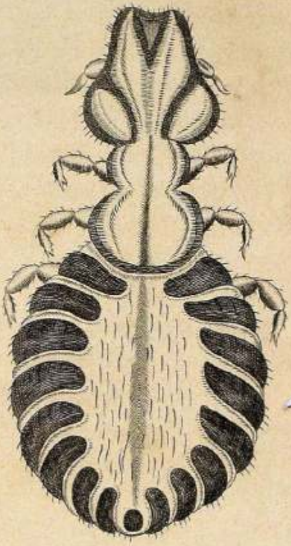
Pedes sex, ambulatorii.	*Legs* six, formed for walking.
Oculi duo.	*Mouth* furnished with an exsertile piercer.
Os aculeo exserendo.	*Antennæ* the length of the thorax.
Antennæ longitudine thoracis.	*Abdomen* depressed, sublobated.
Abdomen depressum, sublobatum.	

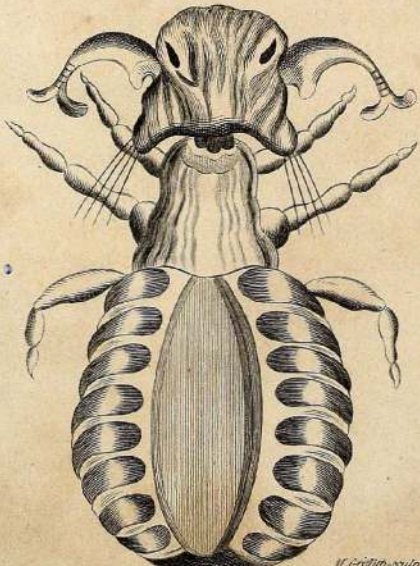
WE now arrive at a very numerous genus of insects, far more remarkable for variety than elegance of appearance. Of these strange and unpleasing animals some infest the bodies of quadrupeds, others of birds, and some even those of insects themselves. It must however be here observed, that many small insects, infesting other animals, have been often referred to the genus Pediculus, which in reality belong to those of Acarus, Monoculus, &c. &c.

The *Pediculus humanus* or common Louse is so well known as to render any very particular description unnecessary. As a species, it is distinguished by its pale livid colour, and lobated, oval abdomen. It is produced from a small oval egg, popularly called by the name of a nit, which is

PEDICULUS.

Crow





M. Griffith sculp

Peacock

1805, Oct. 1 London. Published by G. Kearsley, Fleet Street.

fastened or agglutinated by its smaller end to the hair on which it is deposited. From this egg proceeds the insect, complete in all its parts, and differing only from the parent animal in its smaller size. Such diminutive specimens are far preferable, for microscopic observation, to the full-grown insects, shewing in a more distinct manner the disposition of the viscera, muscles, &c. &c. When thus examined by the microscope, the principal appearances are as follow: viz. the trunk or proboscis, which is generally concealed in its sheath or tube, is of a very sharp form, and is furnished, towards its upper part, with a few reversed aculei or prickles: the eyes are large, smooth, and black: the stomach and intestines, which possess the greater part of the abdominal cavity, afford an extremely distinct and curious view of the peristaltic motion; while the ramifications of the tracheæ or respiratory tubes appear dispersed in an elegant manner throughout various parts of the animal, and are particularly observable towards their orifices on the sides of the abdomen: the legs are each terminated by a double claw, not greatly unlike that of a lobster, but of a much sharper form; and the whole animal is every where covered by a strong, granulated skin*. It is affirmed by

* The magnificent figure of this animal by the ingenious Dr. Hook, engraved in his Micrographia, is well known to all who have attended to the minuter branches of Natural History. It is observed however by Leewenhoek that it is faulty in one particular; the antennæ being represented as consisting of four joints only, instead of five.

Leewenhoek that the male is furnished at the extremity of the abdomen with a sting; and that it is this instrument which causes the chief irritation suffered from these animals; the suction of the proboscis hardly seeming to have caused any perceptible pain on the skin of his hand. The male is readily distinguished from the female* by having the tail or tip of the abdomen rounded: in the female it is forked or bifid. The same accurate observer (Leewenhoek) being desirous of learning the proportion and time of the increase of these insects, placed two females in a black silk stocking, which he wore day and night for that purpose. He found that in six days one of them had laid fifty eggs, and upon dissecting it, he found as many more in the ovary: he therefore concluded that in twelve days it would have laid an hundred eggs: these eggs, hatching in six days, which he found to be their natural time, would probably produce fifty males, and as many females†; and these females, coming to their full growth in eighteen days, might each of them be supposed, after twelve days more, to lay also an hundred eggs; which in six days farther, (the time required to hatch them)

* It is remarkable that Swammerdam appears to have been unacquainted with the difference between the males and females: he even entertained a suspicion that they were hermaphrodites; since, on dissecting forty individuals, he found an ovary in them all.

† This is, perhaps, not a very probable supposition; since it appears from the before-mentioned observation of Swammerdam, that the females are far more numerous than the males.

might produce a younger brood of five thousand; so that in eight weeks a Louse might see five thousand of its own descendants!

The Louse*, in all ages enumerated among the pests of mankind, has been sometimes represented as the mere punishment of personal negligence, and sometimes commemorated as one of the most humiliating concomitants of degraded pride; since, exclusive of the memorable and impressive descriptions on this subject in the sacred writings, we meet with various examples of characters of no small degree of eminence who have suffered from the attacks of this odious insect. The disorder, however, commonly termed *phthiriasis,* is probably more owing to want of attention during the first stages of its appearance, than to any real constitutional cause in the patient; it being entirely contrary to the nature of this insect to get under the cuticle, as commonly supposed; and utterly inconceivable that a complaint merely external should be able to resist mercurial or other preparations outwardly used; and there can be little doubt but that such cases, whenever they occur, would be effectually removed by a proper application of a dilute solution of mercury sublimate. I must even venture to express my doubts whether a real and genuine *phthiriasis,* considered as a primary disease, has ever appeared. Notwithstanding this, we are told by Pliny that Pherecydes

* I here repeat what I have formerly said on this subject in the Naturalist's Miscellany.

Sirius, Sylla the dictator, and others, have died of this disorder. Quintus Serenus speaks thus of the latter.

> "Sylla quoque infelix tali languore peresus
> Corruit, et foedo se vidit ab agmine vinci."

> Great Sylla too the fatal scourge hath known;
> Slain by a host far mightier than his own!

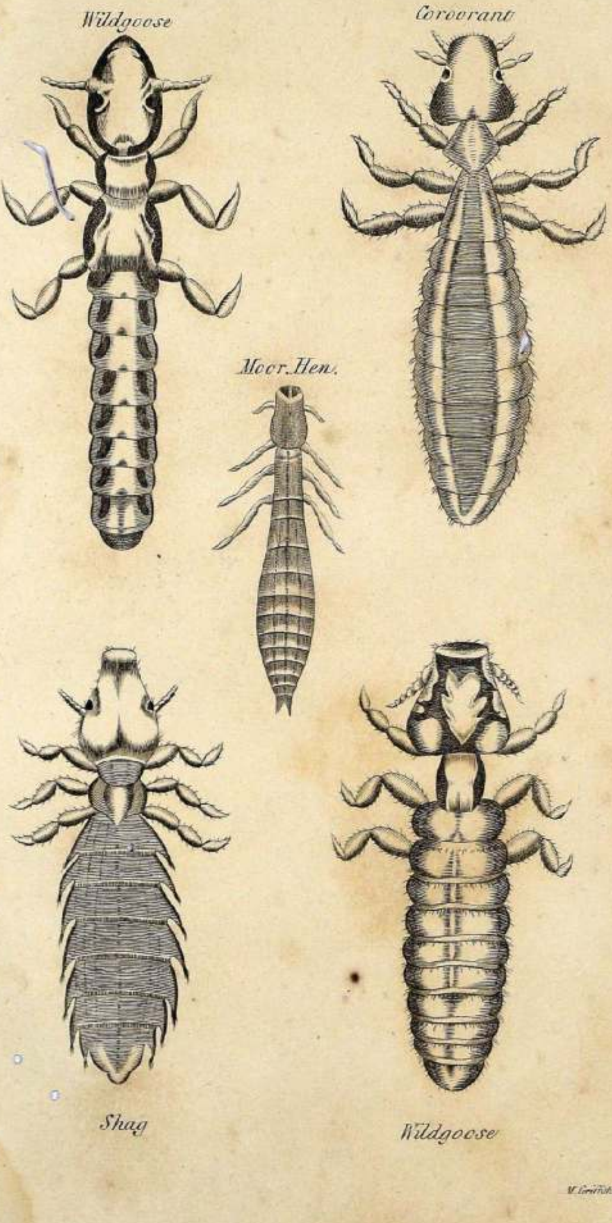
To what I have said respecting this animal I shall beg leave to add the lines of Serenus, as an attempt towards discovering an apparent intention of providence in permitting the frequency of such unpleasing animals.

> "Noxia corporibus quædam de corpore nostro
> Produxit Natura, volens abrumpere somnos
> Sensibus, et monitis vigiles inducere curas."

> See Nature, kindly provident, ordain
> Her gentle stimulants to harmless pain;
> Lest Man, the slave of rest, should waste away
> In torpid slumber life's important day!

Nor can I omit the observation of Linnæus on this subject, who, seemingly anxious to become an apologist for the Louse, has gravely observed that it probably preserves children who are troubled with it, from a variety of complaints to which they would otherwise be liable!!!

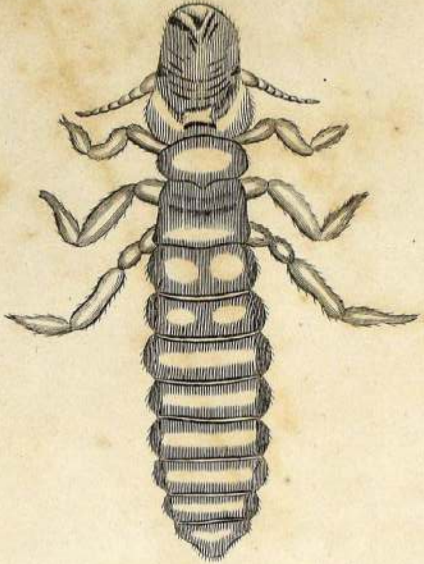
The insects of this genus found on Quadrupeds and Birds may be considered as almost equalling the number of the animals themselves; since few of either division exist without one or more



W. Griffiths sculp.

1805. Octr. 1 London Published by G. Kearsley Fleet Street.

Quail



Heron

M. Griffith sculp.

Partridge

1805. Oct. 1 London Published by G. Kearsley, Fleet Street.

particular species: some are also observed on fishes and insects. It is hardly to be expected that their exact history will ever be distinctly known; and it may be considered as sufficient to point out a few of the most remarkable kinds. Many of these have been long ago observed by the industry of Redi, from whose work on Insects several of the figures here introduced are copied, their respective names being inscribed under each particular species.

PULEX. FLEA.

Generic Character.

Pedes sex, saltatorii.	*Legs* six, formed for leaping.
Oculi duo.	*Eyes* two.
Antennæ filiformes.	*Antennæ* filiform.
Os rostro inflexo, setaceo, aculeum recondente.	*Mouth* furnished with an inflected, setaceous snout, concealing a piercer.
Abdomen compressum.	*Abdomen* compressed.

THE present genus is one of the most singular in the order Aptera. The *Pulex irritans* or common Flea, so well known in its complete state in every region of the globe, is remarkable for undergoing the several changes experienced by the major part of the Insect race of other tribes, being produced from an egg, in the form of a minute worm or larva, which changes to a chrysalis, in order to give birth to the perfect animal. The female Flea deposits, or rather, drops her eggs, at distant intervals, in any favourable situation: they are very small, of an oval shape, of a white colour, and a polished surface. From these, in the space of six days, are hatched the larvæ, which are destitute of feet, of a lengthened, worm-like shape,

Common Flea in its several states, magnified.

1805. Oct. 1 London Published by G. Kearsley, Fleet Street.

beset with distant hairs, and furnished at the head with a pair of short antennæ or tentacula, and at the tail with a pair of slightly curved forks or holders: their colour is white, with a reddish cast, and their motions quick and tortuous. These larvæ are very frequently found in the nests of various birds, and, in particular, of pigeons, where they fasten occasionally to the young brood, and saturate themselves with blood. In the space of ten or twelve days they arrive at their full growth, when they usually measure near a quarter of an inch in length: at this period they cease to feed, and, casting their skin, change into the state of a chrysalis, which is of a white colour, and of an oval shape, with a slightly pointed extremity, and exhibits the immature limbs of the included insect. The larvæ are said to spin themselves up in an oval cotton-like covering before they undergo their change: this however is not always the case. After lying for the space of twelve days in chrysalis, the complete insect emerges in its perfect form. It now begins to exert its lively motions, and employs the sharp proboscis with which Nature has furnished it in order to obtain nourishment from the first bird or quadruped to which it can gain access. The time required for the evolution of this animal varies considerably according to the season of the year, and in the winter months is of much longer duration than the period abovementioned; the egg scarcely hatching under twelve days, and the larvæ lying nearly twice the usual time in chrysalis.

The history of this familiar insect does not appear to have been fully understood till towards the decline of the sixteenth century, when the observations of Leewenhoek and others were directed to it. It is believed however that the first person who investigated all the changes of the animal, from the egg to the perfect Flea, was Signior Diacinto Cestone, an Italian, who communicated the account to the Royal Society of London. This was published in the 149th Number of the Philosophical Transactions, accompanied by figures, which though not conducted with the extreme accuracy which distinguishes the engravings of Roësel and some others, are yet sufficient to give a pretty clear idea of the egg, larva, &c.

Among the chief singularities observable in the structure of the Flea may be noticed the extraordinary situation of the first pair of legs, which instead of being placed beneath the thorax, as in most other insects, are situated immediately beneath the head: the antennæ are short, hairy, and consist of five joints; and at a small distance beneath these is placed the proboscis, which is strong, sharp-pointed, tubular, and placed between a pair of jointed guards or sheaths, which are still farther strengthened at the base by a pair of pointed scales: the eyes are large, round, and black. The general appearance of the animal is too well known to require particular description: it may only be necessary to observe that the male is considerably smaller than the female, with the back rather sinking than convex, as it always is in the female in-

sect. Nothing can exceed the curious disposition and polished elegance of the shelly armour with which the animal is covered; nor can the structure of the legs be contemplated without admiration. All these particulars however are so well represented in the accompanying figures as to supersede the necessity of any long verbal description: they are taken from the exquisite engravings of Roësel, and will be found greatly to surpass in point of minute accuracy even the celebrated figure of Dr. Hook, so much admired in its day, and so often copied into the works of succeeding naturalists.

Though it would perhaps be difficult to prove that there exists in Europe more than one genuine species of Flea, yet it is certain that some permanent varieties or races may be traced, which a practised eye can readily distinguish from the common domestic kind. Of these the most remarkable seems to be that infesting some of the smaller quadrupeds, and particularly Mice and Bats. This variety is of a more slender form than the common Flea and of a paler colour, differing from that insect nearly in the same proportion that a greyhound does from the more common race of dogs.

Pulex penetrans or Chigger is a native of South-America and the West Indian islands. According to Catesby's microscopic figure of this insect, it may properly be arranged under the present genus; but it is probable, from the different descriptions of authors, that some insects of the

genus Acarus, which excite similar swellings under the skin, have been confounded with it under the general name of Chigger or Chigoe. Catesby's account runs as follows.

"It is a very small Flea, that is found only in warm climates: it is a very troublesome insect, especially to Negroes, and others that go barefoot and are slovenly. They penetrate the skin, under which they lay a bunch or bag of eggs, which swell to the bigness of a small pea or tare, and give great pain till taken out; to perform which great care is required, for fear of breaking the bag, which endangers a mortification, and the loss of a leg, and sometimes life itself. This insect in its natural size is not above a fourth part so big as the common Flea. From the mouth issues a hollow tube like that of the common Flea, between a pair of antennæ. It has six jointed legs, and something resembling a tail. The egg is so small as to be scarcely discerned by the naked eye. These Chegoes are a nuisance to most parts of America between the tropics."

Catesby's microscopic figure of the insect represents it with very much the habit of a Flea, with moniliform antennæ of numerous joints, and a caudal tube of the same length with the proboscis, slightly forked at the end.

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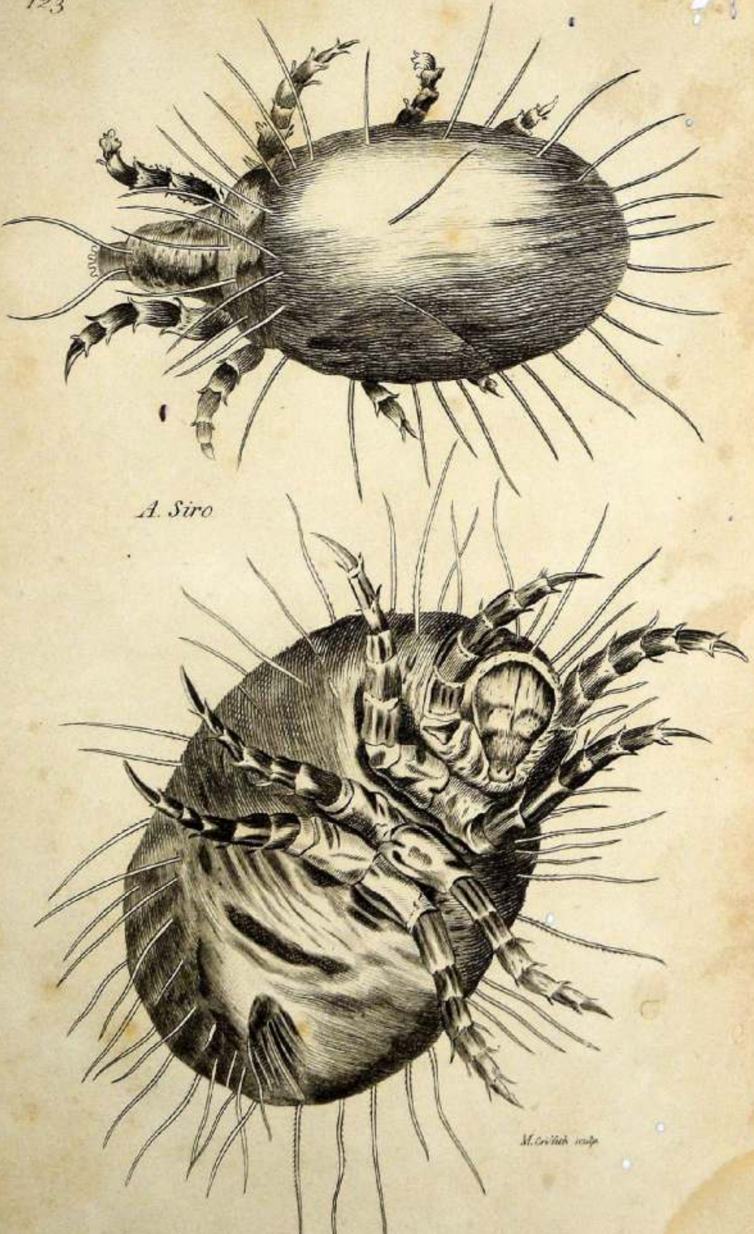


A. Siro

M. Griffith sculp.

1803, Oct.r 1 London, Published by G. Kearsley Fleet Street

ACARUS. MITE.

Generic Character.

Pedes octo.	*Legs* eight.
Oculi duo, ad latera capitis.	*Eyes* two, situated on each side the head.
Tentacula duo, articulata, pediformia.	*Feelers* two, jointed, leg-shaped.

THE genus Acarus is extremely extensive, and the species differ much in size and habit: in general however the Acari are among the most minute of Insects, and are popularly known by the name of Mites.

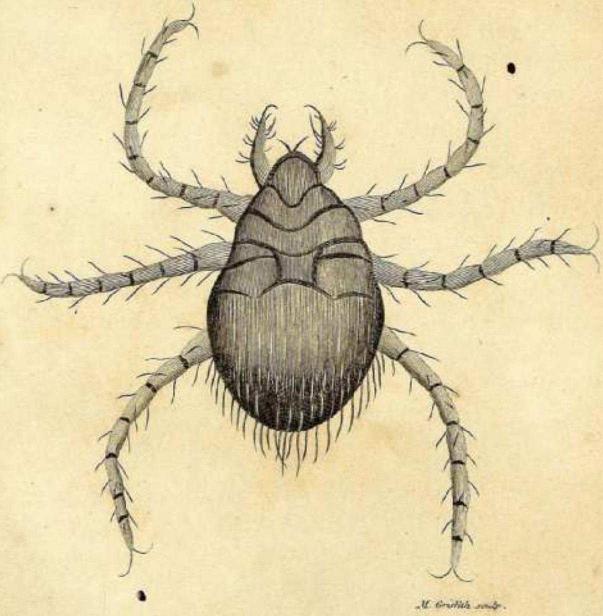
The most familiar species is the *Acarus Siro* or common Cheese-Mite, so frequently observed among various articles of domestic consumption. This little animal is one of those Minutiæ of Nature which amply repay the careful investigation required in order to obtain a complete idea of all its organs;[1] and it forms a favorite subject of microscopic speculation. Our celebrated countryman Dr. Hook has long ago published a most elegant microscopic figure of the Mite, with a good general description; but the more exact elucidation of its form and natural history seems to have been reserved for the penetrating eye of

1

Leewenhoeck, who, exclusive of other particulars, discovered that even the hairs or bristles with which the body is beset, are far from simple filaments, as commonly imagined, but resemble in their structure the awns of barley, being barbed on each side with numerous sharp-pointed processes. Leewenhoeck also observed that the Mite is oviparous, laying very small, white, oval eggs, from which proceed the young animals, resembling the parents in all respects, except in the number of their legs, which, at first, amount to six only; the third pair from the head not making their appearance till after the first casting of the skin. The eggs hatch in warm weather in about six or eight days, but in winter not under some weeks; and it is observed to be not uncommon to see the young animal struggling to get clear of the egg-shell, which sometimes they are a whole day in bringing about.

The Mite, considering its size, is a very voraci ous animal, devouring both animal and vegetable substances with equal avidity. It is also extremely tenacious of life, since we are assured by Leewenhoek that a Mite which he glued to a pin before his microscope, lived in that situation for the space of eleven weeks.

Acarus exulcerans or the Itch Mite, is a species of singular curiosity, not only from the unusual structure of its limbs, but on account of the many controversies relative to its real existence in the particular disease which it has been supposed to produce. In order to take a general view of this



M. Griffith sculp.

A. autumnalis.

1803, Oct.r 1, London, Published by G. Kearsley, Fleet Street.

subject, more curious, it must be confessed, than delicate, we must revert to the decline of the seventeenth century, when Dr. Bononio, an Italian physician, communicated to Redi a description, accompanied by microscopic figures, of the present species of Mite, which he believed, from his frequently repeated observations on persons affected with the complaint above-mentioned, to be the sole cause of the disease. The account of Bononio was introduced by Dr. Mead into the Philosophical Transactions, and may be found in No. 283 of that work. The observation seems to have been received, both in England and elsewhere, as a new and curious discovery. That what may be not improperly called the Acarine Itch was however known in very ancient times is sufficiently clear from the observations of Mouffet, who, in his History of Insects, has given a short abstract of what the older writers have said on the subject, as well as a convincing proof that the complaint was well known in his own days. He relates the case of a Lady Penruddock, aged sixty, who contracted this disorder, as was supposed, by too long a continuance of goat's milk, which she took from apprehension of an approaching consumption. She was, says Mouffet, miserably afflicted with these mites, which the more they were picked out with needles by the care of her nurses, the more their numbers seemed to increase; and at length she fell a victim to the disease.

The above-mentioned Mite is of a slightly rounded, sublobated, and somewhat flattened shape,

with the thighs of the two upper pair of legs extremely thick and short, but the tarsi or continuations very slender, apparently tubular, transparent, and terminating in a rounded tip: the two lower pair of legs have thick, oval-oblong thighs, proceeding from a very slender base, and are extended into an extremely long, stout, curved, and sharp-pointed bristle. The figure of this insect by Bononio, engraved in the Philosophical Transactions, cannot be commended either for elegance or accuracy: that of Degeer is sufficiently correct. This I am enabled to state with confidence, having been favoured with several specimens of this extraordinary animal by Dr. Baker, whose ingenious observations on its nature and qualities were communicated to the Royal Society in the course of the last winter. Dr. Baker, during his residence at the Madeiras, had ample opportunities of investigating the disorder occasioned by it, and is inclined to think that it constitutes a species of Psora distinct from some others which are usually confounded with it, but which arise from some different cause.

Acarus autumnalis, popularly known by the name of the Harvest-Bug, is also one of the most minute of the genus, and is of a bright red colour, with the abdomen beset on its hind part with numerous white bristles. This troublesome insect will make itself sufficiently known to most people during the months of July, August, and September: it is easily distinguishable on the skin by its bright red colour and adheres so tenaciously when

it has once fixed itself, as to be scarcely separated without violence; its motion, when disengaged, is pretty quick, though by no means equal to that of some other Acari. On the part where it fixes it causes a tumor, generally about the size of a pea; sometimes much larger, accompanied by a severe itching. These insects abound on vegetables, and are generally contracted by walking in gardens, amongst long grass, or in corn fields.

According to Mr. White, in his History of Selborne, they abound to an uncommon degree in the chalky districts of that part of Hampshire. He relates that he has been assured that the warreners, in the chalky downs, are so much infested by them, and that they swarm to so infinite a degree as to discolour their nets, and give them a reddish cast, while the men are so bitten as to be thrown into fevers.

Among the larger species of this genus may be numbered the *Acarus Ricinus*, or Tick, so frequently seen on dogs, and sometimes on cattle: it often arrives nearly to the size of a small bean, and is of a livid brown colour, with paler and darker variegations: this animal is furnished between the antennæ with a strong, broad, and flattened snout or proboscis, edged on both sides by a row of strong, sharp, reversed prickles, which serve, when once introduced into the skin, to adhere with such a degree of tenacity as not to be easily removed.

Acarus Reduvius is of a similar nature to the

preceding, and sometimes of nearly similar size: it is found occasionally on cattle, dogs, and some of the larger kind of birds.

Among the animals of this genus which infest Insects themselves the most common species is the *Acarus Coleoptratorum* of Linnæus, which is very frequently seen on the bodies of some of the larger kind of Coleopterous insects, but more particularly on the Scarabæus stercorarius or common black beetle, which may be sometimes seen so covered with its numbers as to be scarcely able to move its limbs. This insect is about thrice the size of the common Mite, of a pale yellowish brown colour, and of an oval shape, with a slightly convex body: its motions are moderately quick, and the feet are terminated by a large vesicular concavity, by the help of which it is enabled to apply itself with security to the glossy surface of the insect which it thus infests.

On the Black Beetle also, as well as on some of the Silphæ, and other coleopterous insects is not unfrequently found that highly curious species of Mite called *Acarus vegetans*, or the vegetating Mite, from the very singular manner in which it is affixed to the limbs or wing-shells of the insect it infests; viz. by a stem or footstalk of considerable length, proceeding from the end of the body, and resembling a tail. This species is much smaller than the preceding, but of similar colour: its shape is nearly hemispherical, the upper or convex part being of a lucid surface. I have some-

times been inclined to suppose that this insect is in reality nothing more than the young of the Acarus Coleoptratorum, and that the eggs of that species are deposited on a footstalk, in the same manner as those of the Hemerobius Perla.

HYDRACHNA. HYDRACHNA.

Generic Character.

Caput, thorax, et abdomen unita.	*Head*, thorax, and abdomen united or connate.
Palpi duo, articulati.	*Feelers* two, jointed.
Oculi duo, quatuor, sex.	*Eyes* two, four, or six.
Pedes octo, natatorii.	*Legs* eight, formed for swimming.

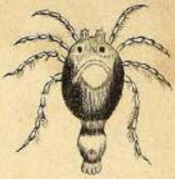
THE genus Hydrachna, allied in the closest manner to that of Acarus, under which the only species known to Linnæus were arranged, was first instituted by the ingenious Müller, by whose industrious researches many new and curious kinds have been discovered.

Among the larger insects of this genus is the *Hydrachna flaccida**, well described by Degeer and others. Its size is that of a small pea, and its colour a very bright red: its shape is nearly globular, but the skin is of such a nature as to yield to every inclination of the body, so that the whole, when taken out of the water, has an irregularly

* I give it this name in order the more clearly to distinguish it from one or two others with which it may sometimes be confounded.

HYDRACHNA.

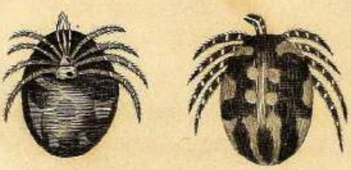
Buccinator



Maculata Degeer

Flaccida

Roëscliana



Geographica

Geog? var.

M.Griffith sculp.

1805. Oct. 1 London. Published by G.Kearsley, Fleet Street.

flaccid appearance: this is most remarkable in the full grown animal, which is also of a much more torpid nature than the rest of the genus, which are animals of great celerity of motion; and indeed the young or unadvanced individuals of the present species are of a more compact appearance, and swim with a greater degree of swiftness than the larger ones. The H: flaccida is not very uncommon in stagnant waters.

Of all the Hydrachnæ yet discovered by far the most elegant is the Hydrachna geographica, so named from the fancied map-like distribution of its variegations. It is one of the largest of the genus, equalling the size of the former: it is occasionally seen in clear ponds and other stagnant waters, but is one of the rarer kinds: its shape is globular, and its colour a polished black, decorated with carmine-coloured spots and patches, which, in a certain light, are accompanied by a kind of gilded lustre: four round spots of this colour are situated on the middle of the upper part of the body, and are bounded by four large, angular patches; besides which, on the sides and lower part of the body, are some others: the legs are varied with black and red, and, as in the rest of the genus, beautifully ciliated with long hairs. This insect swims with great celerity, and appears in almost constant motion. When seen in its state of perfection, it may be numbered among the most beautiful of the British insects.

Hydrachna Roeseliana I name after the incom-

parable Roesel, by whom it is figured in his well known work on insects. It is of equal, or even superior size to the immediately preceding, which, in many points, it seems greatly to resemble; the ground-colour however in this is red, with black variegations, disposed in a different manner from those of the former. It is found, though not very frequently, in stagnant waters.

Among the smaller, or middle-sized Hydrachnæ, one of the most common is the *H: extendens*, which is of the size of a very small hemp-seed, and of a bright red colour, without any variegations: it is extremely nimble in its motions, and always carries the hinder pair of legs, which exceed the rest in length, in an extended posture.

Hydrachna araneoides (*Acarus aquaticus maculatus*. Degeer.) is a small species, of a brown colour, clouded with red, and marked on the back by a very large oval patch of the same colour. It is found, like the rest, in stagnant waters, and has the habit of a young spider.

Some of the genus are distinguished by a kind of cylindric process at the end of the abdomen: of this kind is the *Hydrachna Buccinator*. Lin. *Gmel.* (Acarus caudatus. Degeer.) It is a very small species, of a dark brown colour, with a large rufous patch at the upper part of the body, the cylindric process being of a dull yellow. It is a native of stagnant waters.

The eggs of the Hydrachnæ, which are small and round, are deposited in flat clusters, some-

times on the bodies of Nepæ and other water-insects. The young, when first excluded, are furnished with six legs only; but after the first or second change of their skin, become eight-legged insects.

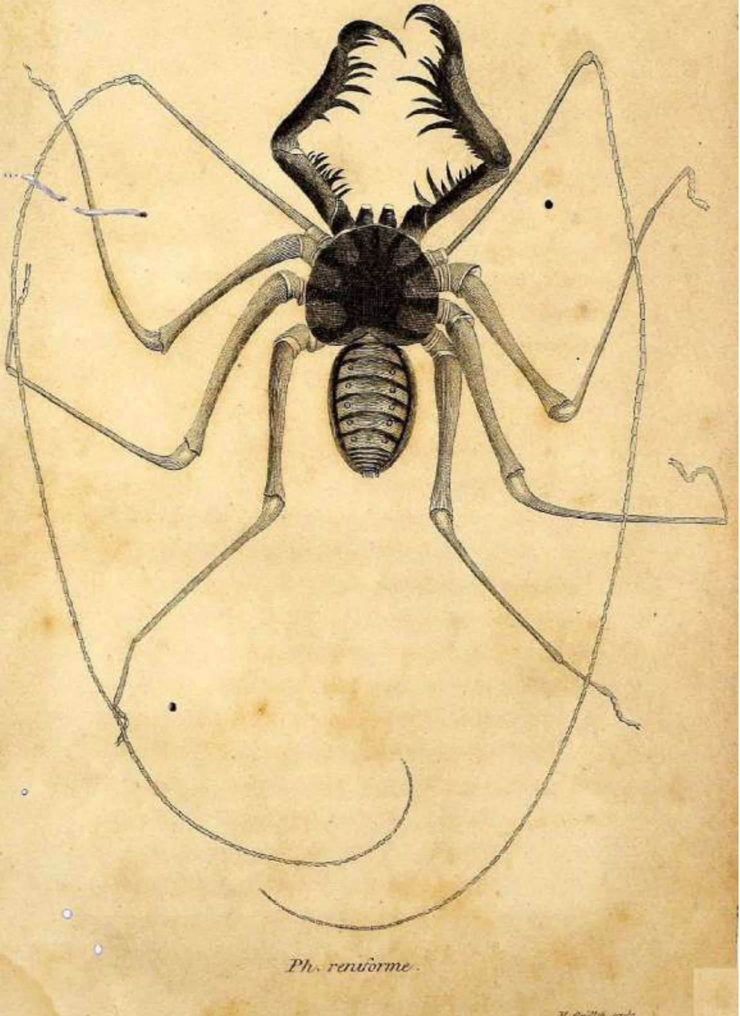
PHALANGIUM. PHALANGIUM.

Generic Character.

Pedes octo.	*Legs* eight.
Oculi verticis duo contigui, duo laterales.	*Eyes* two vertical, and two lateral.
Frons antennis cheliformibus.	*Front* furnished with cheliform antennæ.
Abdomen rotundatum.	*Abdomen*, generally, rounded.

OF all the Insects in the order Aptera few perhaps will be found of a form more repulsive than that of the present genus, which, exclusive of its spider-like shape, is, in some species, armed with weapons resembling those of the genus Aranea, but operating with greater malignity. The Phalangia differ very much in size, some being very minute insects, while others are equal in magnitude to the larger kind of Spiders.

The *Phalangium reniforme* is one of the largest of the genus. This animal is a native of the hotter regions of the globe, being found in Africa and South-America. It has the general appearance of a very large spider, with the thorax heart, or rather kidney-shaped, and the abdomen rounded:



Ph. reniforme.

M. Griffith sculp.

1805. Oct. 1 London, Published by G. Kearsley, Fleet Street.

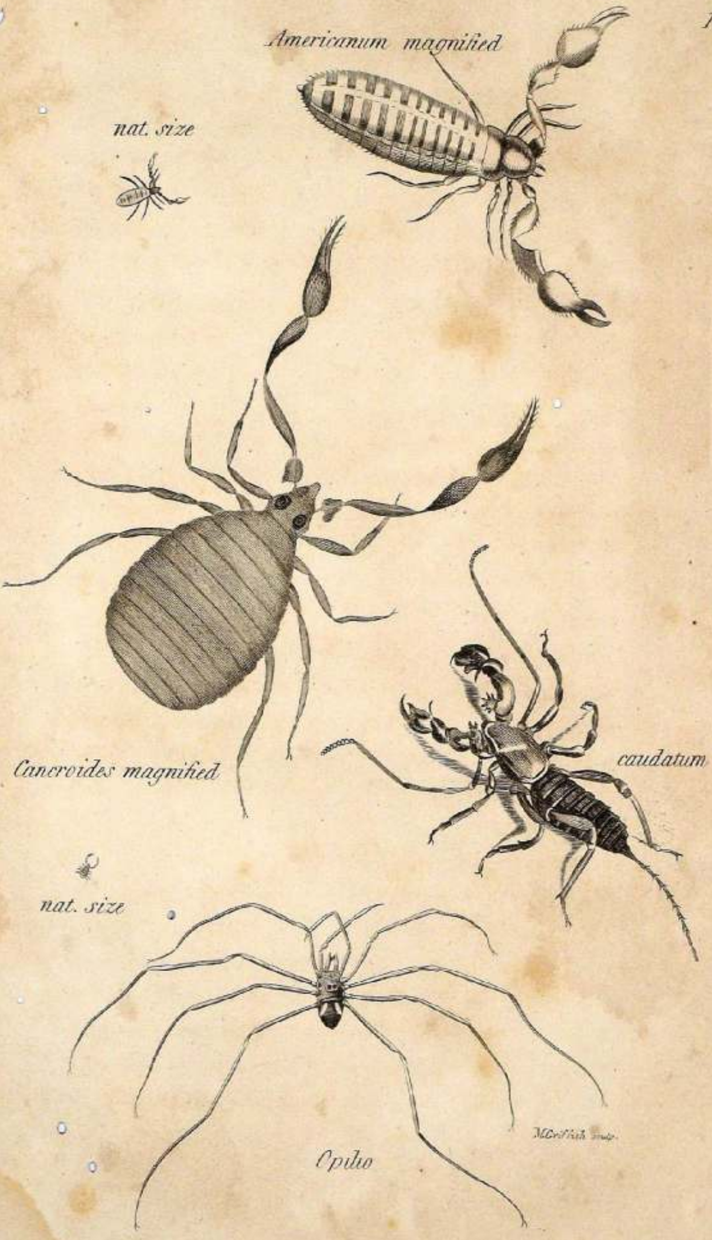
the legs are very long, and the palpi or claspers are strongly toothed on the inner side by several sharp-pointed curved processes: the first pair of legs have all the appearance of a pair of antennæ; far exceeding the rest in length, and being of a slender or filiform shape. The whole insect is of a deep chesnut brown colour, with a yellowish cast on the abdomen. Its particular history seems to be little known, but there can be no doubt of its being of a predacious nature, living, probably, on the smaller insects.

Phalangium caudatum is, in general, of rather smaller size than the former, and of a lengthened shape, with shorter limbs in proportion: it is principally distinguished by the long setaceous process in which the abdomen terminates: the chelæ or claspers are large, and toothed on the inside towards the tips. The general colour of the animal is chesnut brown: it is a native of the East Indies.

To this genus belong those well known insects called long-legged, shepherd, or harvest Spiders, being popularly considered as such, though differing very considerably from Spiders properly so named. The most common insect of this kind is the *Phalangium Opilio* of Linnæus, which, during the autumn, may be observed in gardens, about walls, &c. it is remarkable for its plump, but flattish, orbicular body, and its extremely long and slender legs, which are generally so carried that the body appears suspended or elevated to a considerable

height above the surface on which the animal rests: the eyes are situated on the top of the head, and resemble two very minute glassy globules: the colour of the whole animal is a pale greyish brown. This species preys on the smaller kind of insects in general.

Among the minute species of Phalangium the most remarkable is the *P. cancroides* of Linnæus, a very small insect, of a reddish brown colour, and of slow motion, occasionally found among papers, dried plants, &c. &c. Its shape is obtusely oval, with a sharpened front, furnished with a pair of very long and large jointed claspers, which give the insect a very remarkable appearance: the body is very much depressed. This little insect has been occasionally referred to very different genera. The celebrated Swammerdam considered it as a species of Scorpion; and of the same opinion was the ingenious Roesel, in whose work on insects it is well figured. In the Fauna Suecica of Linnæus it is made an Acarus, and Degeer institutes for it a particular genus under the name of Chelifer. It is a species which seems to vary considerably in size; those which are found in our own country rarely exceeding the length of the tenth of an inch, while in some parts of Europe it appears to arrive at twice that length. It is said by Linnæus, but, probably, on no just foundation, to introduce itself occasionally under the skin, and to excite a painful tumor; a circumstance, which, considering the size of the animal, seems scarcely



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possible. It preys on the smaller and weaker kind of insects, as the Termes pulsatorium, the larvæ of Ptini and Dermestides, &c.

Phalangium Americanum is extremely allied to the immediately preceding, but differs in being of a somewhat larger size, and of a paler colour: the body is also of a much more lengthened form. It is found in many parts of America. In our own country we have a species very much resembling it, but smaller and of a dark brown colour: it is sometimes distinguished by the name of the Lobster-Insect.

I shall add the description of one more species to this genus; an animal which, if we may rely on the most respectable authorities, must undoubtedly be numbered among the most formidable of the whole Insect tribe. This is the *Phalangium araneoides*, of Pallas, nearly similar in size to the Ph: caudatum, of a lengthened form, a brown colour, and covered with downy hair: the claspers are short, but very large in proportion to the animal, and the tips are toothed internally, in such a manner as to bear a resemblance to a lobster's claw. This insect is a native of the warmer parts of the South of Europe, and of Africa, inhabiting fields, and by its bite producing most painful swellings on the skin, and even, as it is said, sometimes proving fatal. Mr. Herbst, in his excellent work on the Aptera, has ranked this species, with some others of a similar appearance, under a distinct genus of the name of Solpuga.

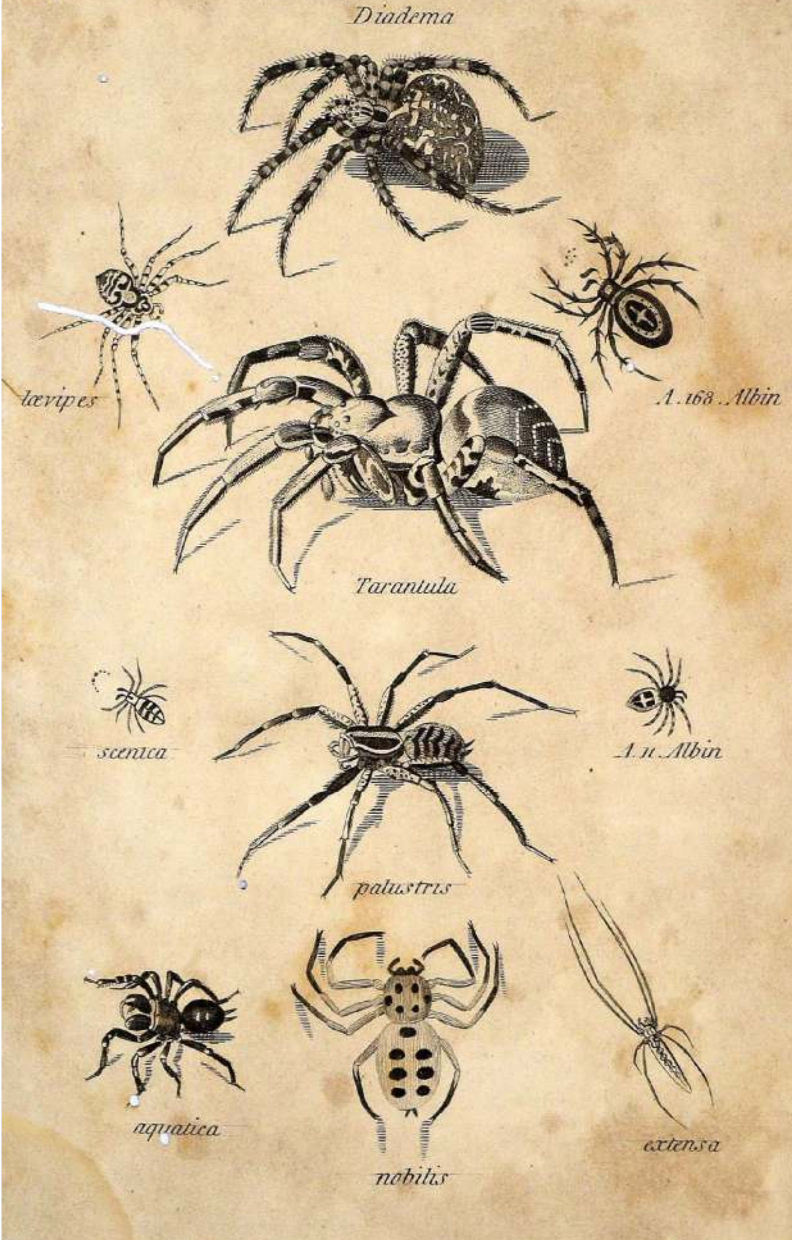
ARANEA. SPIDER.

Generic Character.

Pedes octo.	*Legs* eight.
Oculi octo; rarius sex.	*Eyes* eight; sometimes six.
Os unguibus, seu retinaculis duobus.	*Mouth* furnished with two hooks or holders.
Palpi duo articulati; masculis genitalibus capitati.	*Feelers* two, jointed, the tips of which, in the male, distinguish the sex.
Anus papillis textoriis.	*Abdomen* terminated by papillæ or teats, through which the insect draws its thread.

THE very extensive genus Aranea may be distributed into several sections according to the shape or habit of body, or according to the position of the eyes, which are differently placed in the different families. I shall at present however mention only a few of the most remarkable species, without any particular division of the genus.

One of the largest of the European spiders is the *Aranea Diadema* of Linnæus, which is extremely common in our own country, and is chiefly seen during the autumnal season in gardens, &c. The body of this species, when full



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grown, is not much inferior in size to a small hazel nut: the general colour of the animal is deep chesnut-brown, approaching to reddish in some specimens, and the abdomen is beautifully marked by a longitudinal series of round or drop-shaped milk-white spots, crossed by others of similar appearance, so as to represent in some degree the pattern of a small diadem. This spider, in the months of September and October, forms, in some convenient spot or shelter, a large round, close, or thick web of yellow silk, in which it deposits its eggs, guarding the round web with a secondary one of a looser texture. The young are hatched in the ensuing May, the parent insects dying towards the close of Autumn. The male of this species is distinguished by having the back crossed by four or five black-brown bars. The Aranea Diadema being one of the largest of the common spiders serves to exemplify some of the principal characters of the genus in a clearer manner than most others. At the tip of the abdomen are placed five* papillæ or teats, through which the insect draws its thread; and as each of these papillæ is furnished with a vast number of foramina or outlets, disposed over its whole surface, it follows that what we commonly term a spider's thread is in reality formed of a collection of a great many distinct ones; the animal possessing the power of drawing out more or fewer at

* In some species four; and in some are two smaller papillæ, the nature of which is doubtful.

pleasure; and if it should draw from all the foramina at once the thread might consist of many hundred distinct filaments. The eyes, which are situated on the upper part or front of the thorax, are eight in number, placed at a small distance from each other, and having the appearance of the stemmata in the generality of insects. The fangs or piercers, with which the animal wounds its prey, are strong, curved, sharp-pointed, and each furnished on the inside, near the tip, with a small oblong hole or slit, through which is evacuated a poisonous fluid into the wound made by the point itself, these organs operating in miniature on the same principle with the fangs in poisonous serpents. The feet are of a highly curious structure; the two claws with which each is terminated being furnished on its under side with several parallel processes resembling the teeth of a comb, and enabling the animal to dispose and manage with the utmost facility the disposition of the threads in its web, &c.

Aranea Tarantula, or Tarantula Spider, of which so many idle recitals have been detailed in the works of the learned, and which even to this day continues, in some countries, to exercise the faith and ignorance of the vulgar, is a native of the warmer parts of Italy and other warm European regions, and is generally found in dry and sunny plains. It is the largest of all the European spiders, and is of a brown colour, with the back of the abdomen marked by a row of trigonal black spots with whitish edges, and the legs marked beneath by

black and white bars. In the present illuminated period it may be sufficient to observe that the extraordinary symptoms supposed to ensue from the bite of this insect, as well as their supposed cure by the power of musick alone, are entirely fabulous, and are now sufficiently exploded among all rational philosophers.

Aranea nobilis is a very beautiful species, of middling size, with an orange-coloured thorax, marked by six black spots, and an oval, yellow abdomen with seven oval black spots, the first of which is situated immediately behind the thorax, while the remainder are disposed into two longitudinal rows: the legs are yellow, with the last joints black. This elegant spider is a native of Sumatra.

Aranea scenica is a small species by no means uncommon during the summer months, and generally seen on walls in gardens, &c. it is of a black colour, with the abdomen marked on each side the upper part by three white bars. This spider is one of those which spring suddenly, to some distance, on their prey.

Aranea extensa is a smallish species, of a fine green colour, accompanied by a slight silvery gloss: it is common in gardens, and is almost always seen with the legs extended, in a parallel line with the body.

Aranea lævipes is of a grey colour, varied with minute black specks, and with the legs beautifully crossed by numerous alternate black and white bars.

Aranea palustris is of a lengthened form and of a brown colour, and is principally seen in damp or watery places.

Aranea aquatica is a middle-sized species of a deep chesnut-colour, residing entirely under water, generally in very clear ponds or fountains, and forming for itself a small tissue or web confining a proper quantity of air: sometimes this species is observed to take possession of a vacant shell, in which case it closes the mouth with a slight web.

The exact distinction of species in this genus, especially among the smaller kinds, is often extremely difficult and uncertain; since the animals are sometimes differently marked during the different periods of their life: some however are in this respect perfectly constant, bearing the same distribution of colours from their first hatching to their latest period.

The gigantic *Aranea avicularia* or Bird-Catching Spider is too remarkable an insect to be passed over in silence. This enormous spider is not uncommon in many parts of the East Indies and South-America, where it resides among trees; frequently seizing on small birds, which it destroys by wounding with its fangs, and afterwards sucking their blood: the slit or orifice near the tip of the fangs in spiders, through which the poisonous fluid is evacuated, and the existence of which has sometimes afforded so much matter of doubt among naturalists, is in this species so visible that it may be distinctly perceived without the assistance of a glass.

ARANEA.

A. avicularia

M. Griffith sculp.

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This animal appears to admit of some varieties, differing both in size and colour; or rather, it is probable that several species, really distinct, have been often confounded in the works of naturalists under one common title. The individual represented on the annexed plate is copied from one of the largest specimens in the Leverian Museum: its colour is an uniform dusky brown.

During the early part of the last century a project was entertained by a French gentleman, Monsr. Bon of Montpelier, of instituting a manufacture of spider's silk, and the Royal Academy, to which the scheme was proposed, appointed the ingenious Reaumur to repeat the experiments of Monsr. Bon, in order to ascertain how far the proposed plan might be carried; but, after making the proper trials, Mr. Reaumur found it to be impracticable, on account of the natural disposition of these animals, which is such as will by no means admit of their living peaceably together in large numbers. Mr. Reaumur also computed that 663522 spiders would scarcely furnish a single pound of silk. Mon^{r}. Bon however, the first projector, carried his experiments so far as to obtain two or three pair of stockings and gloves of this silk, which were of an elegant grey colour, and were presented, as samples, to the Royal Academy. It must be observed that in this manufacture it is the silk of the egg-bags alone that can be used, being far stronger than that of the webs. Monsr. Bon collected twelve or thirteen ounces of these,

and having caused them to be well cleared of dust, by properly beating with sticks, he washed them perfectly clean in warm water. After this they were laid to steep, in a large vessel, with soap, salt-petre, and gum arabic. The whole was left to boil over a gentle fire for three hours, and were afterwards again washed to get out the soap; then laid to dry for some days, after which they were carded, but with much smaller cards than ordinary. The silk is easily spun into a fine and strong thread: the difficulty being only to collect the silk-bags in sufficient quantity.

Mons[r]. Reaumur, among his objections, states, that the thread, notwithstanding Mr. Bon's description, is far inferior to that of the silkworm both in lustre and strength: the thread of the spider's web, according to this author, bears a weight of only twelve grains without breaking; whereas that of the silkworm bears the weight of thirty-six.

The egg-bags used for the purpose were, probably, those of the Aranea Diadema, and others nearly allied to it.

We have before observed that these insects are but ill calculated for living in society. Whenever thus stationed, they never fail to wage war with each other. The females in particular are of a disposition peculiarly capricious and malignant, and it is observed that if the male happens to pay his courtship at an unfavourable moment, the female suddenly springs upon him and destroys

him. On this occasion, says Linnæus, if ever, may be justly applied the Ovidian line

Res est solliciti plena timoris amor!

There remains one more particularity in the history of Spiders with which I shall conclude the description of the genus, viz. the power of flight. This is chiefly exercised by those of less advanced age, and seems possessed but in an inferior degree by those which are full grown. It is principally in the autumnal season that these diminutive adventurers ascend the air, and contribute to fill it with that infinity of floating cobwebs which are so peculiarly conspicuous at that period of the year. When inclined to make these aerial excursions, the spider ascends some slight eminence, as the top of a wall, or the branch of a tree, and, turning itself with its head towards the wind ejaculates* (according to Dr. Lister) several threads, and, rising from its station, commits itself to the gale, and is thus carried far beyond the height of the loftiest towers, and enjoys the pleasure of a clearer atmosphere. During their flight it is probable that spiders employ themselves in catching such minute winged insects as may happen to occur in their progress; and when satisfied with their journey and their prey, they suffer themselves to fall, by contracting their limbs, and gradually

* The ejaculation or darting of the threads is doubted by Swammerdam and some others, who rather suppose that the threads are driven by the wind from the papillæ of the animal.

disengaging themselves from the thread which supports them. This curious particular in the history of Spiders was first observed by Dr. Hulse, about the year 1668, and was soon confirmed by Dr. Lister and Mr. Ray. Dr. Lister made several very accurate observations on this subject, and even ascended some of the highest edifices on purpose to observe it, and saw spiders sailing as far as the eye could reach above these, till at length they vanished from his view. (See Phil. Trans. No. 50. p. 1014.)

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SCORPIO. SCORPION.

Generic Character.

Corpus ovato-elongatum.	*Body* ovate-elongated.
Pedes octo; insuper Chelæ duæ frontales.	*Legs* eight, besides two frontal claspers.
Oculi octo; tres at latus utrumque thoracis; duo in tergo.	*Eyes* eight: three on each side the thorax, and two on the back.
Cauda elongata, articulata, terminata mucrone arcuato.	*Tail* elongated, jointed, and terminated by a curved piercer.
Pectines duo subtus, inter pectus et abdomen.	*Combs* or toothed processes two, situated beneath, between the thorax and abdomen.

THE malignant genus Scorpio, so proverbially remarkable for the effect of its poisonous sting, seems chiefly confined to the warmer parts of the globe, and may be considered as a stranger to the northern regions. The common Italian Scorpion usually measures something more than an inch in length from the head to the setting on of the tail; but, if measured from the tips of the claspers to the tip of the tail, about three inches: its colour is brown, with considerable variation in

different individuals, some inclining to a reddish, and some to a yellowish cast. This animal is found in neglected places, beneath boards, stones, &c. and frequently makes its appearance in houses: its sting is painful, but seldom productive of any very serious consequences, and the usual remedy is sweet oil, well rubbed on the punctured part. Like the rest of the genus, this insect preys on other insects, and particularly on spiders.

Scorpio Americanus or the American Scorpion is of somewhat smaller size than the preceding, and of a more slender or lengthened form: its colour is a yellowish brown. It is a native of many parts of America.

The largest and by far the most formidable of the genus is the *Scorpio Afer* of Linnæus, or great African Scorpion. This species is of so large a size as often to measure four inches from the head to the beginning of the tail, and ten inches, if measured from the tips of the claspers to that of the tail. Its colour is a dark brown, inclining to yellow beneath, and in the interstices of the joints; and the claspers have often a reddish cast. This species is found in many parts of Africa, where it is held in great dread; the effect of its sting producing very severe symptoms, and sometimes even proving fatal.

The poison of the Scorpion is evacuated through two very small oblong foramina situated on each side the tip of the sting. It is well known that a diversity of opinion has subsisted among authors relative to this particular. The celebrated Redi,

assisted by the best microscopes he could procure, was not able detect any orifice, though he was well convinced of the existence of such, from observing a minute drop of poison exsude from near the tip. Others have denied the existence of any foramen; but Vallisneri and Leewenhoek have properly described two foramina, viz. one on each side; so that the sting of the scorpion can with greater facility discharge its poisonous fluid than that of any other Insect. A third foramen is said to have been sometimes observed*.

The part in Scorpions which is situated beneath the breast, bearing the appearance of two minute combs, has been fixed upon by Linnæus as a criterion of the species; the number of teeth however, varying occasionally in the same species, renders this character uncertain. The use of these organs remains as yet uninvestigated.

Scorpions are viviparous insects, producing a very considerable number of young at once: these are at first entirely white, but acquire their dusky colour in the space of a few days, they are observed to cast their skin from time to time, in the manner of Spiders.

Several fabulous anecdotes of these animals have been recorded by the older writers on natural history which are totally unworthy of being related in the present enlightened age. One of the most remarkable of these legends is, that a Scorpion surrounded by live coals, finding no

* Scorpionum arma foraminibus tribus scatent. *Lin. Syst. Nat.*

method of escaping, grows desperate from its situation, and stings itself to death. It is not uncommon to hear this quoted with serious credulity as the only instance of suicide amongst the inferior animals.

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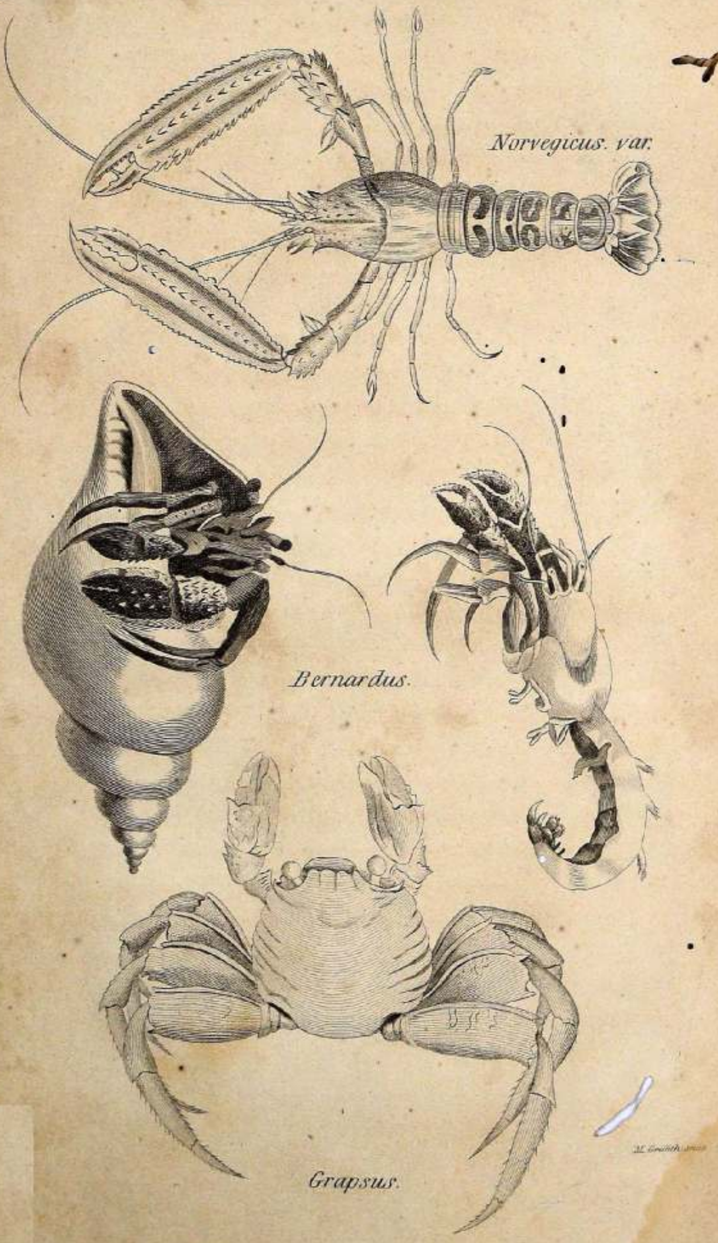

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CANCER. CRAB.

Generic Character.

Pedes octo (rarius sex aut decem) insuper manus duæ chelatæ.	*Legs* eight, (sometimes six or ten) besides two chelated arms.
Oculi duo, distantes, plerisque pedunculati, elongati, mobiles.	*Eyes* two, distant, generally footstalked, elongated, moveable.
Cauda articulata, inermis.	*Tail* jointed, unarmed.

THE* genus Cancer is distinguished not more by the singularly curious shape and appearance of the animals it contains, than by the vast variety of species into which it is divided; the number of which is so great that it is found necessary to subdivide them into sections, according to their different shape or general habit, in order that they may be the more readily investigated. Some are of a short, thick, and nearly orbicular form, and sometimes the transverse diameter of the body considerably exceeds the longitudinal: others are of a thin and long form: some are strongly muri-

* This introduction to the genus Cancer is, in great measure, repeated from what I have before written on the same subject in the Naturalist's Miscellany.

cated; others perfectly smooth: some are furnished with very strong and large chelæ or claws; others have only weak, unarmed feet: lastly, some are remarkable for their great size, while others are so diminutive as to require the assistance of glasses in order to determine the structure of their several parts.

The animals of this genus cast their shells from time to time. When this period approaches, the limbs gradually shrink or waste in size, so as to enable them to be drawn with greater ease from the claws and other parts of the shell. The animal then lies in a quiet state for some days, till the new shell is formed, or rather till it is hardened; for at first it is rather membranaceous than crustaceous. Some species have the body naturally destitute of a shelly covering; in consequence of which they never fail to take possession of such vacant univalve shells as happen to suit their convenience; the body being immersed in the shell, while the claws remain exserted.

The loss of a limb, an accident so dreadful and irremediable to the major part of the animal world, is to these creatures of but little importance; since the space of a few weeks supplies the defect, and restores them to their former state. What is still more wonderful, these animals, when injured, maimed, or bruised on any particular limb, do not wait for the process of a gradual recovery of that individual part, but, as if conscious of the power of reproduction, voluntary cast off with sudden violence the offending member, and re-

taking themselves to a state of retirement, await the formation of their new limb. Most of the genus are very prolific; the female of the common Lobster is said to produce upwards of twelve thousand eggs each time of laying. In this genus also we find examples of deviation from that general symmetry of parts, so conspicuous in most other animals, in which the shape of the body and limbs on one side exactly corresponds to that of the other; many of the Cancri being furnished with a pair of chelæ or claspers which on one side are of an immoderate size, while those on the opposite side are thin and small; and in some particular species, as the Cancer vocans, &c. the size of the large arm is so great as to oblige the animal to support it on its back, in which position it is generally placed while the creature is walking. It may likewise be added that this is a particularity which is sometimes reversed; a circumstance which occasionally takes place, as is well known, in the univalve shells.

The principal division of the genus is into *Brachyuri* and *Macrouri*, or the short-tailed and long-tailed. Of the former division the *Cancer Pagurus* or large edible Crab affords a familiar example. This animal has a smooth body, with a notched or crenated thorax, five-toothed front, and smooth claws with black tips: it grows to a very large size, and inhabits the rocky coasts of our own island as well as of many other parts of Europe.

Cancer Grapsus or streaked Crab is a native of

the Indian and American seas: the body is of a pale yellowish colour, beautifully variegated with red streaks and specks: the sides of the thorax are marked by several transverse pleats, and the front notched into four obtuse denticulated divisions.

Among the Cancri macrouri or long-bodied Cancri the common Lobster may serve as a familiar example. This species, as every one knows, is found in great plenty about many of the European shores: its colour, when living, is a fine blueish black, beautifully variegated on different parts with paler spots and clouds. Its general habitation is in the clearest water, about the foot of such rocks as impend over the sea. Lobsters begin to breed in the spring, and continue breeding during part of the summer: they deposit their eggs in the sand, where they are said to be soon hatched: it is observed however, that those which are cast before the warm season seldom arrive at perfection. In the months of July and August the young may be observed in great numbers in the little pools left by the tide among the rocks: when recently hatched, they have an appearance distantly resembling that of tadpoles, but gradually obtain the form of the complete animal.

Cancer Norvegicus, a native of the northern seas, is of a more lengthened or slender form than the Lobster, and with thinner claspers in proportion, of an angular shape, and roughened by strong protuberances along the angular elevations. Its natural colour is said to be pale red, with yellow markings or variegations.

A more beautiful animal than the preceding is the *Cancer Homarus* or embroidered Cancer, in which the colour, at least in the dried specimens, is a deep greenish blue, with a similar yellow pattern, so disposed as to give the animal the appearance artificially painted in stripes, &c. I suspect that real specific differences exist between some animals of this division which are confounded under the general name of Cancer Homarus.

Cancer Astacus or the Crawfish is a well-known inhabitant of our rivers, lodging in holes which it forms in the banks.

Among the smaller kind of the long-bodied Cancri the *Cancer Crangon* or Shrimp is one of the most remarkable. It is found in vast abundance round many of the European coasts, and is, when living, of a beautiful greyish green colour sometimes inclining to blue, and sometimes tinged with brown.

Some of this genus, as has been before observed, are destitute of a shelly covering to the body, and, in consequence, are obliged to obtain security from danger by inhabiting some close retirement: the most common species of this kind is the *Cancer Bernardus* of Linnæus, commonly known by the name of the hermit-crab. It enters into any vacant univalve shell which is capable of conveniently receiving its body, and when in motion protrudes only the head and fore-parts, coiling the hind part of the body round the pillar of the shell. It is a very frequent inhabitant of common shells of the

genera of Murex and Buccinum. Its general colour is pale red.

Among the smaller kind of fresh-water Cancri the *Cancer stagnalis* is the chief: this is an insect of great elegance, and is occasionally found in small stagnant waters, at first sight rather suggesting the idea of the larva of some kind of Dytiscus than of a species of Cancer. Its length is about an inch and half, and its colour pale blueish green: the male is furnished with a pair of strong hooked jaws or processes of which the female is destitute: this latter is generally distinguished by its ovarium, of a pointed shape and of a brownish colour.

In clear springs, ponds, &c. may be frequently observed a species much smaller than the former, viz. the *Cancer Pulex* of Linnæus. This measures about half an inch in length, and is of a livid brown colour; it generally swims with considerable celerity but with a vertiginous kind of motion, and commonly on one side.

I must not dismiss the genus Cancer without observing that, by one of those revolutions in science which sometimes take place, this whole genus is, at present, in danger of being expelled from the class of Insects, and of ranking in a separate department.

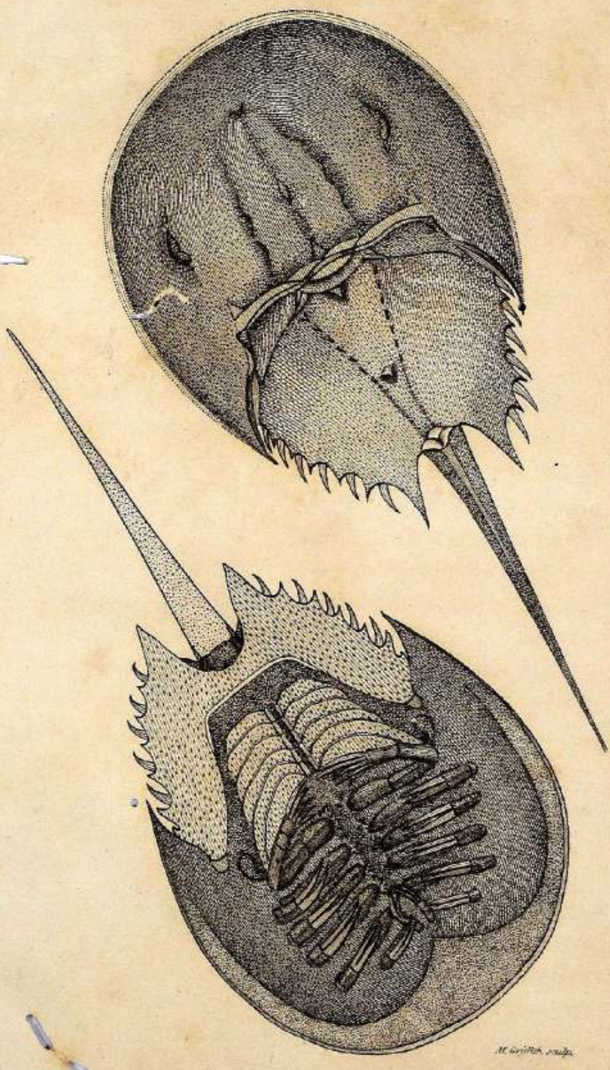
MONOCULUS. MONOCULUS.

Generic Character.

Pedes natatorii.	*Feet* formed for swimming.
Corpus crusta tectum.	*Body* covered by a crustaceous tegument.
Oculi, plerisque, approximati, testæ innati.	*Eyes*, in most species, approximated, and imbedded in the shell.

OF the Monoculi by far the major part are very small water-insects, requiring the assistance of a microscope for the investigation of their particular organs: some however are so large as to require no very minute inspection; and one species in particular, (if indeed it can be allowed to stand with propriety in the genus) is of a size so gigantic that it is generally considered as the largest of the whole crustaceous tribe. This animal is the *Monoculus Polyphemus* of Linnæus, commonly distinguished by the title of Molucca Crab or King-Crab. Specimens are sometimes seen of two feet in length, exclusive of the tail. It is a native of the Indian ocean, and is said to be generally found in pairs, or male and female swimming together. The colour of the whole animal is a yellowish brown: the shell is very convex, rounded

in front, and lunated behind, where it joins the lower part of the body: this, which is of the same crustaceous nature, is marked on each side into several spiny inscisions: the legs which are seven on each side, are situated beneath the concavity of the large or rounded part of the shell, and are each terminated by a double claw, those of the lowest pair having some additional processes: the branchiæ or respiratory organs are disposed in the form of several flat, rounded, imbricated lamellæ on each side the lower part of the body: the tail, which is strait, triangular, and of the same crustaceous nature with the rest of the shell, is equal in length to the whole body, and gradually tapers to a sharp point. The eyes in this species, instead of being approximated, as required in the Linnæan generic character, are extremely distant from each other, being situated towards the sides of the shell: they are of a semilunar form, and the surface is divided into a great number of minute conical convexities: this part however should be considered only as constituting the cornea or exterior covering of each eye; the organs themselves being, according to the observations of Mr. Petiver, in the Philosophical Transactions, placed on a pedicle beneath each of the above-mentioned semilunar corneæ. Petiver's words are these. "The whole structure of this animal is very remarkable, and particularly his eyes, viz. between the fourth and last pair of claws on each side, reckoning from his mouth, and excluding the small pair there placed, are inserted the rudiments of another pair,



M. Polyphemus.

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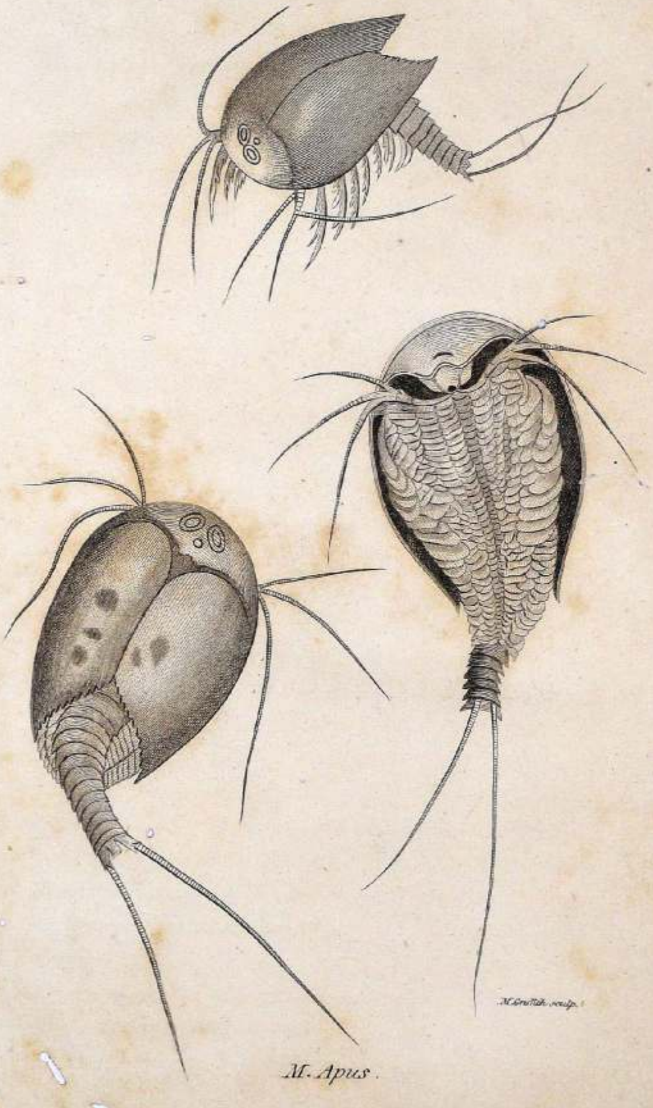
or a claw broken off on each side at the second joint or elbow; on these extremities are the eyes, like those of the horns of snails, but under the covert of a thick and opake shell Nature in that place has wonderfully contrived a transparent lantern, through which the light is conveyed, whose superficies very exactly resembles the great eyes of our large libellæ or adderbolts, which to the naked eye are plainly perceived to be composed of innumerable globuli: these, like them, are oblong, and guarded by a testaceous supercilium."

Of the European Monoculi by far the largest is the *Monoculus Apus*, which, when full-grown, measures nearly an inch and three quarters from the front to the end of the body, exclusive of the forked divisions of the tail. It is found in muddy stagnant waters, but is a rare species in this country, having been only observed in a few particular situations. In its general shape it is considerably allied to the large exotic species before described, but the body is of a more lengthened form in proportion, with the hinder part naked, and divided into numerous joints: the branchiæ or respiratory organs, are large, and are distributed into numerous imbricated rows on the under part of the body: beneath the front is a pair of jointed, trifid arms, extending on each side to a considerable distance: the eyes are placed near each other in front of the shell: the tail is terminated by a pair of long forks or setaceous processes. The colour of the whole insect is a pale greenish

brown above, and reddish beneath. We are informed in vol. 40 of the Philosophical Transactions that this insect has been found in great plenty in a pond on Bexley Common in Kent. It is also added, that the same pond, having been perfectly dried, and being suddenly filled during a heavy thunder-storm, swarms of the same animal were again observed in it within the space of two days after.

Monoculus Pulex, called, from its peculiar starting or springing motion, the Water-Flea, is an almost universal inhabitant of stagnant waters, appearing sometimes in such vast swarms as to cause an apparent discoloration of the water itself. It is an insect of a highly singular and elegant appearance, exhibiting, when magnified, a beautiful distribution of internal organs. Its general length is about the tenth of an inch, but it is sometimes seen considerably larger: its shape is oval, somewhat truncated in front, and sharply pointed behind: the body is inclosed in a bivalve, transparent shell, which when examined by the microscope appears finely reticulated: on each side the head is a strong transparent jointed arm, forking into two divisions, and terminating in several setaceous branches: the tail which is generally inclosed within the shell, is occasionally protruded in the form of a strong curved and pointed process: the eyes of this animal are of a singular construction; they are large in proportion to the insect, placed very near each other, and appear to consist of many separate globules, of a



M. Griffith sculp.

M. Apus.

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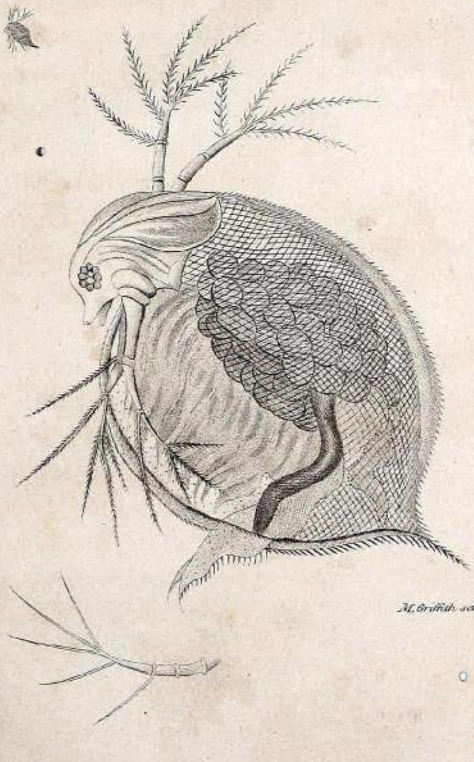

M Pulex in its natural size,
& magnified

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black colour, united under a common skin. In the female insect the ovarium is generally very conspicuous, filling the greater part of the space between the shells, above the branchiæ or side-limbs: the ova are very large in proportion to the animal, and the young hatch before their exclusion from the parent. From late observations it appears that this animal possesses, in an inferior degree, the surprizing property of the genus Aphis, viz. that of producing a series of already impregnated descendants.

The minute *Monoculus quadricornis* or four-horned Monoculus, must have frequently met the eyes of every one; since it is not only extremely common in every stagnant water, but sometimes makes its appearance in that of pumps, wells, &c. and is in consequence occasionally observed in water brought to the table. Its size is not greatly superior to that of a common mite, but its shape is oblong or lengthened, and the female is remarkable for the appearance of the ovaria, which are attached, on each side the tail, in such a manner as to resemble bunches of grapes in miniature: on each side the head are two long, jointed arms, resembling four very long antennæ: the tail is long and bifid: the general colour of the whole insect is white, but it is sometimes seen of a green, and sometimes of a reddish cast.

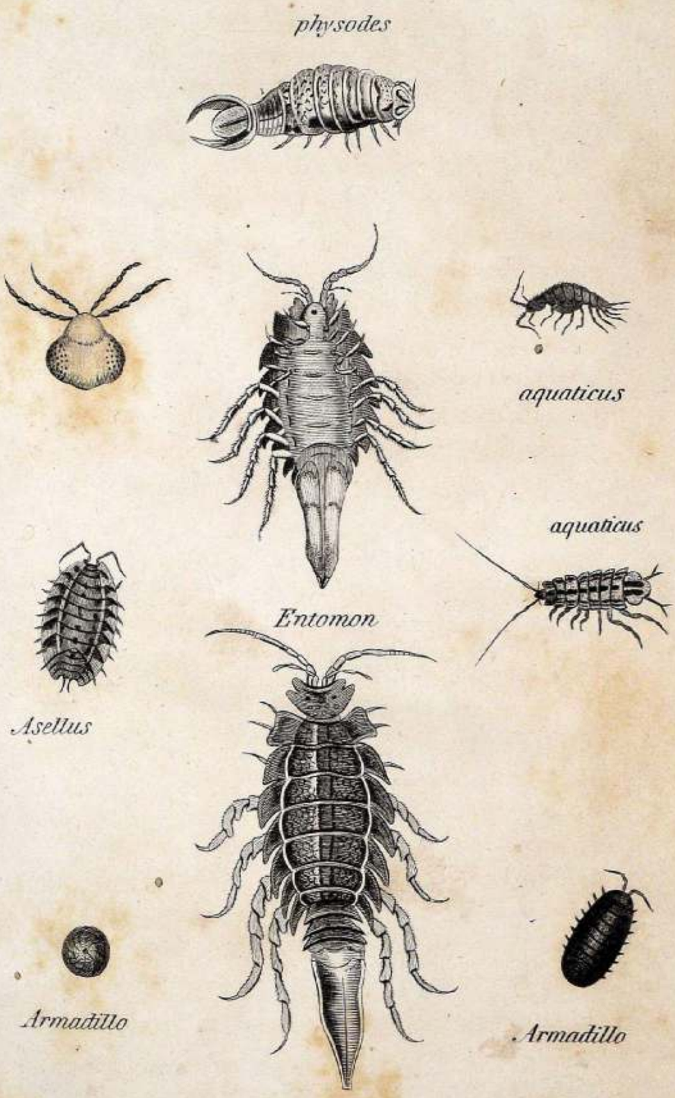
ONISCUS. ONISCUS.

Generic Character.

Pedes quatuordecim.	*Legs* fourteen.
Antennæ setaceæ.	*Antennæ* setaceous.
Corpus ovale.	*Body* oval.

OF this genus, which is not very numerous, the most common species is the *Oniscus Asellus*, popularly known by the name of the woodlouse. It is a very common insect in gardens, fields, &c. and is observed in great quantities under the barks of decayed trees, beneath stones in damp situations, &c. Its general length is about half an inch or rather more, and its colour livid brown; the larger specimens often exhibiting a double series of pale spots down the back: like the rest of the genus it preys on the minuter insects.

Oniscus Armadillo or the Medical Woodlouse is of somewhat larger size than the preceding, of a much darker colour, and of a polished surface: it is equally common with the preceding species, and is found in similar situations: when suddenly disturbed or handled, it rolls itself up into a completely globular form, in the manner of the curious



M.Griffith sculp.

1803 Oct. 1 London. Published by G. Kearsley Fleet Street

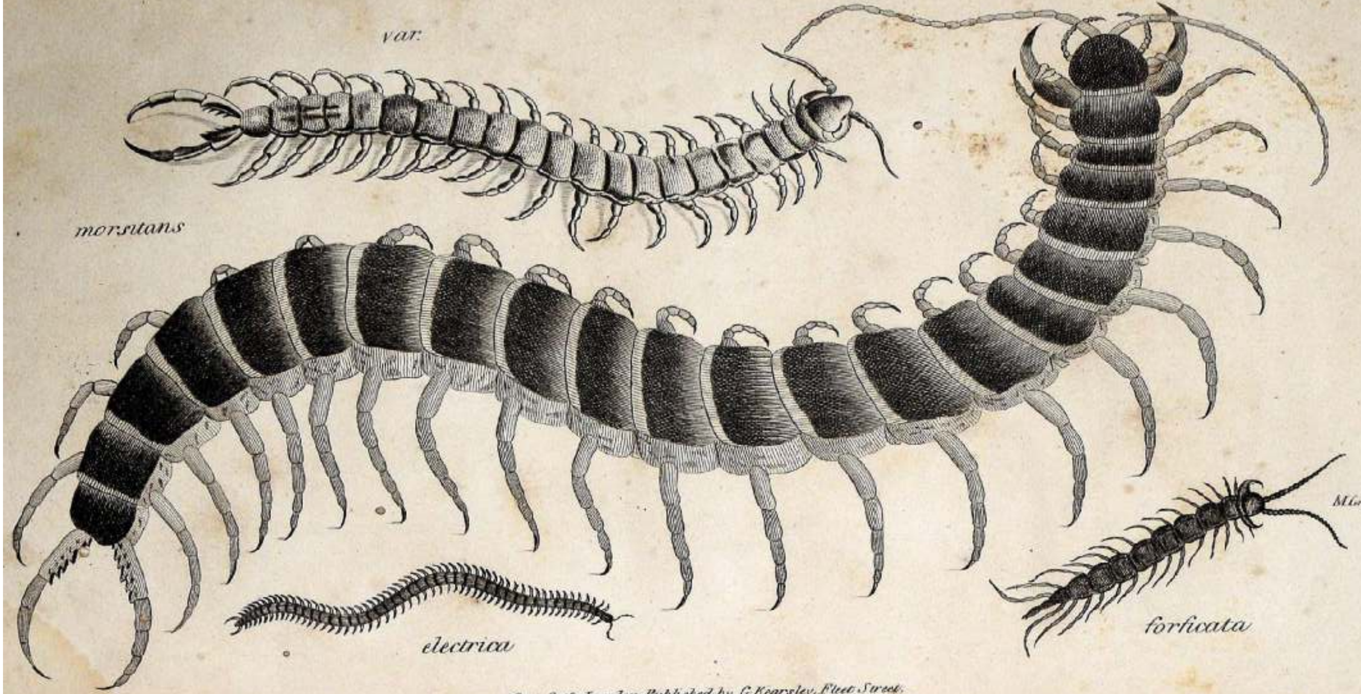
Quadrupeds called Armadillos; frequently remaining in this state for a very considerable length of time, or so long as it is any ways disturbed. Swammerdam relates a ludicrous mistake of a servant maid, who, finding in the garden a great many in this globular state, imagined she had discovered some handsome materials for a necklace, and betook herself to stringing them with great care; but on suddenly perceiving them unfold, was seized with a panic, and ran shrieking into the house.

Though considered as of but slight importance in the present practice of physic, these animals once maintained a very respectable station in the materia medica, under the title of *Millepedes;* being regarded as aperient, resolvent, &c. &c. They were ordered in cases of jaundice, asthma, and many other disorders, and were either taken living, being swallowed, like pills, in their contracted state, or variously enveloped in syrops and marmalades; but were more generally reduced to a powder and thus mixed with other ingredients.

Oniscus aquaticus is a native of the clearer kind of stagnant waters, and is of the general size and colour of the Oniscus Asellus, but of a more lengthened form, and with longer limbs in proportion; the two last legs being bifid. In the female the ovary is very distinguishable, in the form of a large inflated valve beneath the body. This species is viviparous, and of a considerably prolific nature.

Among the marine insects of this genus the largest is the *Oniscus Entomon*, measuring two inches in length: its general form and colour resembles that of the O: Asellus, but the four lower pair of legs are longer in proportion, the three first pair being very small and short: the tail is long and pointed. It is a native of the European seas, and is found about rocks, &c. It is of a strong fabric, the divisions of the upper part being of an almost calcareous nature. This animal is capable of living several days in fresh water.

SCOLOPENDRA.



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SCOLOPENDRA. CENTIPEDE.

Generic Character.

Antennæ setaceæ.	*Antennæ* setaceous.
Corpus depressum.	*Body* depressed.
Pedes numerosi, totidem utrinque quot corporis segmenta.	*Legs* numerous, equalling the number of segments of the body on each side.
Palpi duo articulati.	*Feelers* two, setaceous.

THE larger species of the genus Scolopendra, found only in the hotter regions of the globe, are insects of a formidable appearance, and possess the power of inflicting severe pain and inflammation by their bite. Of these one of the most conspicuous is the *Scolopendra morsitans**, a native of many parts of Asia, Africa, and South America. Its length is sometimes not far short of ten inches: its colour is yellowish brown, the legs and under parts of the body being much paler: the head is armed on each side with a very large curved fang, of the same strong or horny nature as those of the Aranea Avicularia, but placed in a different direc-

* The Linnæan characters of the gigantea and morsitans seem very uncertain: his gigantea has seventeen legs on each side; and morsitans twenty.

tion, the two fangs meeting horizontally when in action: these fangs are furnished on the inside, near the tip, with an oblong slit, through which, during the act of wounding, an acrimonious or poisonous fluid is discharged: the eyes are several in number on each side the head, and are placed in a small oval groupe: the legs are twenty on each side the body, and the tail is terminated by a pair of processes, which perfectly resemble the rest of the legs, except that they are larger, and have the first joints strongly spined or muricated on the inside. These horrible insects are said to be chiefly found in woods, but, like the small European species, they are occasionally seen in houses, and are said to be so common in some particular districts that the inhabitants are obliged to place the feet of their beds in vessels of water, in order to prevent their attacks during the night.

Scolopendra Plumieri or Plumier's Scolopendra is of much greater length than the former, sometimes measuring a foot and a half: it is figured in the sixth plate of Lister's Journey to Paris, from a drawing by the celebrated Father Plumier, who had then lately arrived from America: it is also elegantly represented in the first volume of Seba's Thesaurus, under the title of *Millepeda major ex Nova Hispania*. According to the description and figure of Seba, the body consists of thirty-two joints, exclusive of the head and tail. Seba's figure must also be supposed by far the most correct of the two, that of Plumier, in the work above referred to, having rather the appearance of a

general representation of the animal than of a highly accurate figure, the legs seeming to be too numerous, and some of the first pairs bifid at the tips.

Scolopendra forficata is a very common insect, and is met with in similar situations with the Oniscus Asellus and Armadillo: it is an animal of swift motion, and is furnished with fifteen legs on each side: its colour is a polished chesnut brown, somewhat paler beneath, and its usual length an inch and half.

Scolopendra electrica is, like the former, an inhabitant of damp situations, and not unfrequently makes its appearance in houses: its general length is about an inch and half, and its diameter scarcely more than the tenth of an inch; being of an extremely long and slender form: its colour is a dusky brown, with the legs yellowish: these are about seventy on each side. The motions of this insect are tortuous and undulatory, seldom continuing long in the same direction: it is possessed of a high degree of phosphoric splendor, which however seems to be only exerted when the animal is pressed or suddenly disturbed, when it diffuses a beautiful smaragdine light, so powerful as not to be obliterated by two candles on the same table. It is also tenacious of life, remaining seemingly uninjured for a great many days in the closest confinement.

Scolopendra subterranea so much resembles the former, that it might be easily confounded with it: it is however of a still more slender form, and

of a much paler colour, viz. a light yellow brown: it is found in damp places, and often under ground; is not possessed of any phosphoric splendor, nor is it capable of surviving many hours in a state of confinement, unless placed in a very moist situation.

The Scolopendræ are oviparous animals, and the young, at their first exclusion, are furnished only with a few feet on each side; acquiring after a certain period, the legitimate number peculiar to their species.

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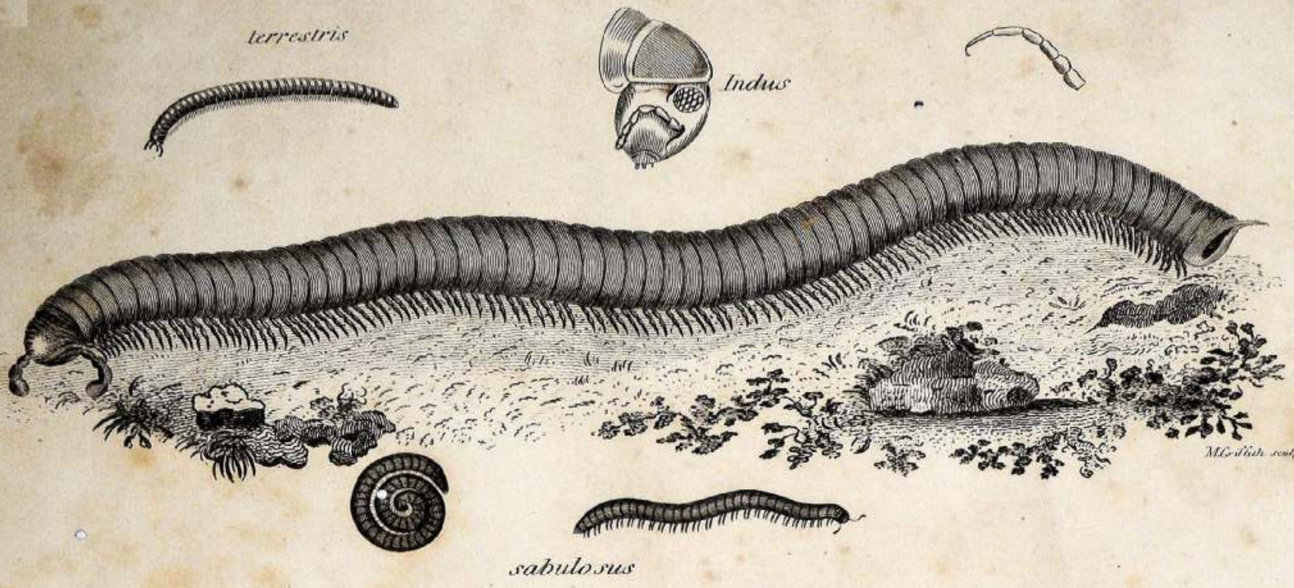
JULUS.



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JULUS. JULUS.

Generic Character.

Antennæ moniliformes.
Palpi duo articulati.
Corpus subcylindricum.
Pedes numerosi, duplo utrinque plures quam corporis segmenta.

Antennæ moniliform.
Feelers two, jointed.
Body subcylindric.
Legs numerous, twice as many on each side as the segments of the body.

THE Juli are very nearly allied to the Scolopendræ or Centipedes, but their body, instead of being flattened, as in those insects, is nearly cylindrical; and every joint or segment is furnished with two pair of feet, the number on each side doubling that of the segments, whereas in the scolopendræ the number of joints and of feet is equal on each side. The eyes of the Juli are composed of numerous hexagonal convexities, as in the major part of the insect tribe, and the mouth is furnished with a pair of denticulated jaws. These animals, when disturbed, roll themselves up in a flat spiral: their general motion is rather slow and undulatory. The most common species, the *Julus sabulosus* is often seen in similar situations with the Onisci and Scolopendræ, and usually measures about an inch and quarter in length: its

colour is a polished brownish black, except the legs which are pale or whitish: it is an oviparous animal, and the young, when first hatched, are very small, of a whitish colour, and are furnished only with three pair of legs, which are situated on each side the superior part, or near the head; the remaining pairs not making their appearance till some days after, when about seven on a side become visible: the rest are gradually acquired till the number is complete, which usually amounts, according to Linnæus, to an hundred and twenty on each side: so long as this species continues in its young or growing state it is of a pale colour with a dark red spot on each side of every segment: in this state it may sometimes be found in the soft mold of hollow trees.

Julus Indus or Great Indian Julus bears an extreme resemblance to the former, but is of such a size as to measure six or seven inches in length: its colour is similar to that of the preceding. It is found in the warmer parts of Asia and America, inhabiting woods and other retired places, the number of legs, according to Linnæus, is an hundred and fifteen on each side, but this seems to be a variable character.

In Dr. Lister's ingenious publication entitled "A Journey to Paris*" we find a representation of an extremely large animal of this genus, from a drawing by Father Plumier: it is a native of South America, and is the Julus maximus of Linnæus:

* Published in 1694.

its colour is brown with a kind of brassy or metallic tinge, and the number of legs on each side is an hundred and thirty-four. This species occurs in plate 81. vol. 1. of Seba's Thesaurus, under the name of *Millepeda Orientalis omnium maxima.*

Julus lagurus or Hare-Tailed Julus is a very minute and singular species, not exceeding, when at full growth, the eighth of an inch in length. Its colour is pale brown, and its shape rather broad, and flattish, the body consisting of eight segments only, each beset on the sides with a fringe of flattened hairs of a whitish colour: a row of similar hairs, but much shorter, runs also across the upper part of each segment: the head is large, and ornamented in front by a similar fringe, while the tail is furnished with two lengthened milk-white plumes or tufts of white down. This insect is by no means uncommon, being seen during the summer months creeping about the barks of trees, walls, &c. It is considered by Linnæus as a species of Scolopendra, but as the legs are double the number of the segments on each side, it is more properly referred by Degeer, Scopoli, and others to the present genus. In fact it may be allowed, like the *Julus complanatus*, another slightly flattened species, to form a kind of connecting link between the two genera.

END OF VOLUME VI.

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